FEEDING COTTONSEED PRODUCTS TO LIVESTOCK

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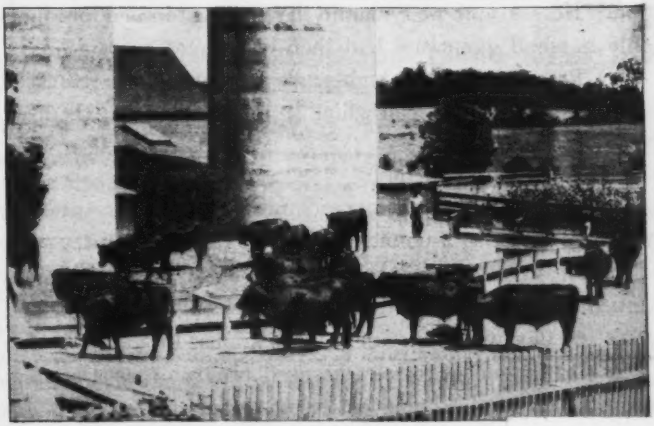

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UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from the Bureau of Animal Industry
JOHN R. MOHLER, Chief

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THE FOLLOWING POINTS have been determined from experiments and practical feeding operations. They should be kept in mind and carefully followed in feeding cottonseed products to livestock:

(1) Do not feed cottonseed meal to young calves.

(2) Horses and pigs should be fed cottonseed products only in small quantities and then with great precaution.

(3) Procure prices on high-grade and low-grade cottonseed meal and choose the feed which supplies protein at the least cost.

(4) For feeding cattle:

(*a*) One pound of cottonseed meal is usually considered worth as much as 2 pounds of corn or its equivalent.

(*b*) Heavy rations of cottonseed meal should be discontinued after 100 to 120 days when dry roughage is fed, and after 150 days when succulent feeds are used.

(*c*) Cottonseed cake may be used profitably as a supplemental feed for fattening cattle on pasture.

(5) In sections where much corn, stover, fodder, timothy, or other carbohydrate feed is used it is extremely important that some feed like cottonseed meal be used.

(6) Cottonseed meal stimulates the appetites of fattening animals and causes them to consume more feed and likewise to make greater gains.

(7) Cottonseed meal is a very valuable protein feed for dairy cows. One pound of good-quality cottonseed meal is usually considered equal to 2 pounds of wheat bran for milk production.

FEEDING COTTONSEED PRODUCTS TO LIVESTOCK.[1]

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VALUE OF COTTONSEED PRODUCTS AS LIVESTOCK FEEDS.

Cottonseed products have been used extensively for stock feeding in the South for many years. During more recent times their use has become general in many sections outside the Cotton Belt. The demand from foreign countries is strong, despite the fact that these products cost considerably more there than they do in this country. European feeders, as a rule, have placed more value on high-protein feeds than the average American livestock man.

Another reason why cottonseed products are of such great importance, in addition to their high-protein content, is their immense production. Although the production of cotton has shown a slight decrease during the last 10 years, the decrease has not been so marked as has been the case with flaxseed, from which linseed meal [2] is made. Several new protein feeds, like peanut cake, copra cake, and fish meal, have been offered on the market during the last few years, but with the average stockman they have not been received with so much favor as cottonseed meal or linseed meal, due in part to their unknown value. These newer products, however, promise to become of more importance in the future, because some of them have distinct advantages over cottonseed products for certain classes of farm animals.

COMPOSITION OF COTTONSEED PRODUCTS.

There are a large number of cottonseed products used as livestock feeds. Both concentrates and roughages are included. All the concentrate products have the same general characteristics and qualities, their chemical composition depending mainly upon the form of manu-

[1] This bulletin supersedes Farmers' Bulletin 655, "Cottonseed Meal for Feeding Beef Cattle."

[2] This product is also known as "oil meal," and "new-process" and "old-process" meal.

facture and the thoroughness in separating out the hulls. Among the more common cotton products used as feeds are cotton seed, cottonseed meal and cake, and cottonseed hulls. Table 1 gives analyses representing these products, which have been put on the market by manufacturers to conform to the definitions adopted by the Association of Feed Control Officials of the United States.

TABLE 1.—*Composition of cottonseed products.*[1]

[Pounds of nutrients in 100 pounds.]

Product.	Water.	Ash.	Crude protein.	Carbohydrates.		Fat (ether extract).
				Fiber.	Nitrogen-free extract.	
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Cotton seed	6.6	3.7	21.7	19.7	26.9	21.4
Cottonseed meal:						
Choice	6.4	5.9	43.3	10.0	25.7	8.7
Prime	6.6	6.1	38.9	13.2	28.5	6.7
Good	6.5	5.8	37.8	13.6	30.6	5.7
Cold-pressed cottonseed cake	6.2	4.7	25.8	24.0	31.5	7.8
Cottonseed hulls	8.5	2.4	2.8	48.6	37.4	.3

[1] Furnished by the Bureau of Chemistry, United States Department of Agriculture.

GRADES AND CLASSES OF COTTONSEED PRODUCTS.

Formerly cotton seed (uncrushed) was used quite extensively as a feed for livestock. Its value as a source of cottonseed oil and its utilization for commercial purposes has greatly decreased the amount fed in the form of seed. Cottonseed products have taken the place of the seed as a feedstuff. Several feeding tests have indicated that 1 pound of good-quality cottonseed meal is equal to nearly 2 pounds of cotton seed as a feed for fattening steers. Large rations of cotton seed tend to produce scours, but when used in quantities up to 5 or 6 pounds there is little or no trouble from this source.

Cotton seed contains about 21 per cent fat or oil and nearly 22 per cent crude protein. Compared with a good grade of cottonseed meal it contains about half as much protein and about two and one-half times the content of oil.

A ton of cotton seed will yield approximately the following quantities of products:[2]

	Pounds.
Linters or short fiber	110
Hulls	514
Cake or meal	954
Crude oil	303
Loss in manufacture	119
Total	2,000

Cottonseed cake is made from the residue which remains after the oil has been extracted from the seed. Ordinarily the greater

[2] Average for the 5 years 1914–15 to 1918–19 as compiled by the Bureau of Markets, United States Department of Agriculture, from Bureau of Census figures and estimates.

part of the hulls is removed before the oil is extracted. When this is done the amount of crude fiber in the resulting cake is proportionately smaller. The hulled kernels are crushed, heated, and subjected to great pressure to remove the oil. The residue when of good quality should be a hard, boardlike cake of a yellowish color. The color is often an indication of the quality. The presence of hulls causes the cake to become dark. A dark color may also be caused by overheating during the pressing process or by fermentation, each of which lessens the feeding value.

Cottonseed cake and cottonseed meal are practically one and the same thing; that is, the meal is the cake in a ground form. The meal is most commonly used, but the cake has a distinct advantage in certain cases. European buyers show a preference for the cake for the reasons that there is less loss in handling, it is easier to judge the quality, and because the cake is better adapted for feeding alone or on the ground.

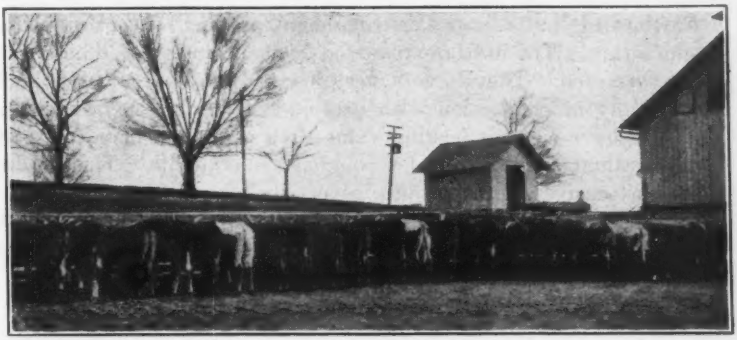

FIG. 1.—Tennessee steers, fattened chiefly upon cottonseed meal and silage. (Courtesy of the Tennessee Experiment Station.)

In the United States the cake is preferred by men who feed their cattle in the open where the wind may blow the meal away. On the range or pasture the cake is often broken up and fed in troughs or spread upon the ground. If meal were used, the loss in feeding in this manner would be very large.

There are many grades and classes of cottonseed products sold on the market. The grades as classified and described by the Association of Feed Control Officials of the United States are as follows:

1. Cottonseed meal.
2. Choice cottonseed meal.
3. Prime cottonseed meal.
4. Good cottonseed meal.
5. Cottonseed feed.
6. Cold-pressed cottonseed (cake).
7. Ground cold-pressed cotton seed.

Cottonseed meal is a product of the cotton seed only, composed principally of the kernel with such portion of the hull as is necessary in the manufacture of oil; provided, that nothing shall be recognized as cottonseed meal that does not conform to the foregoing definition and that does not contain at least 36 per cent of protein.

Choice cottonseed meal must be finely ground, not necessarily bolted, perfectly sound and sweet in odor, yellow, free from excess of lint, and must contain at least 41 per cent of protein.

Prime cottonseed meal must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color, yellow, not brown or reddish, free from excess of lint, and must contain at least 38.6 per cent of protein.

Good cottonseed meal must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color, and must contain at least 36 per cent of protein.

Cottonseed feed is a mixture of cottonseed meal and cottonseed hulls, containing less than 36 per cent of protein.

Cold-pressed cotton seed is the product resulting from subjecting the whole undecorticated cotton seed to the cold-pressure process for the extraction of oil, and includes the entire cotton seed less the oil extracted.

Ground cold-pressed cotton seed is the ground product resulting from subjecting the whole undecorticated cotton seed to the cold-pressure process for the extraction of oil, and includes the entire ground cotton seed less the oil extracted.

Cottonseed hulls are the roughage product of cottonseed-oil manufacture. The hulls are removed from the cotton seed before the oil is extracted. They have a very low-protein content and should be fed only in connection with protein-rich feeds. As a roughage the hulls have a lower feeding value than oat straw or corn stover, but are valuable where no other roughage is available. This product is used extensively in the South, especially for steer feeding.

Cottonseed-hull bran is ground cottonseed hulls from which the lint has been removed. The feeding value of the bran is not appreciably greater than that of ordinary cottonseed hulls.

POISONOUS EFFECTS OF COTTONSEED PRODUCTS.

Cottonseed products, though valuable feeds, are not always safe feeds, especially when fed to certain animals. Experience has shown that their use as a feed for young calves and pigs may result fatally. Just what causes the harmful effects is not known. The products may be used for a limited time with no visibly harmful effects, but their continued use may be fatal. Until more is learned concerning the toxicity of cottonseed meal, it is well to feed it sparingly and with extreme caution to young calves and pigs. It is less harmful to older cattle, but when fed continuously and in large amounts for long periods it may also prove to be harmful even to them. Formerly steers were frequently fed, in the vicinity of cotton-oil mills, as much as from 12 to 15 pounds of cottonseed meal per head per day. As a result of such heavy feeding many became blind, exhibited a staggering gait, and occasionally the legs swelled below the hocks. Some died, while others ceased to gain in weight, went off feed, and then rapidly lost flesh. Even though the feed was changed much

trouble was experienced in getting the animals back to a normal appetite and a thrifty condition. Horses and mules may also be seriously affected by the toxic properties of cottonseed meal when it is used in more than limited amounts.

Cottonseed meal, fed in small or moderate amounts, is constipating. For that reason it should be used with more laxative feeds, such as silage, and as a supplement to other concentrates. Its rational use with a variety of feeds will usually overcome the difficulty.

ECONOMY OF USING HIGH-GRADE COTTONSEED PRODUCTS.

Cottonseed products containing a high percentage of protein command relatively high prices, but judged from the cost of the protein contained, they are comparatively cheap. Some feeders prefer to buy the lower-grade products, believing them to be more economical than the better grades. From the standpoint of the cost of the protein in the feeds such men are usually deceiving themselves. These products are usually purchased for their protein content and prices paid should be based on the protein contained in them. To show the value per pound of the protein in feeds at various prices and containing varying guaranteed analyses of protein, Table 2 has been prepared.

TABLE 2.—*Cost of protein per pound in feeds at various prices per ton.*

Cost of feed per ton.	Per cent of protein in feeds.										
	12	16	20	24	28	32	36	38	41	43	45
	Cost per pound of protein.										
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
$25.00	10.42	7.82	6.25	5.23	4.47	3.91	3.47	3.29	3.05	2.91	2.77
30.00	12.50	9.38	7.50	6.25	5.36	4.69	4.16	3.95	3.66	3.48	3.38
35.00	14.58	10.94	8.75	7.29	6.25	5.47	4.86	4.61	4.26	4.07	3.89
40.00	16.67	12.50	10.00	8.33	7.14	6.25	5.55	5.26	4.88	4.65	4.44
45.00	18.75	14.06	11.25	9.38	8.03	7.03	6.25	5.92	5.49	5.23	5.00
50.00	20.83	15.63	12.50	10.42	8.93	7.81	6.94	6.58	6.09	5.81	5.55
55.00	22.91	17.19	13.75	11.46	9.82	8.59	7.64	7.24	6.71	6.40	6.11
60.00	25.00	18.75	15.00	12.50	10.71	9.38	8.33	7.89	7.32	6.97	6.67
65.00	27.08	20.31	16.25	13.54	11.67	10.16	9.03	8.55	7.92	7.56	7.22
70.00	29.16	21.87	17.50	14.58	12.50	10.94	9.72	9.21	8.53	8.14	7.78
75.00	31.25	23.44	18.75	15.62	13.39	11.72	10.41	9.87	9.14	8.72	8.33
80.00	33.33	25.00	20.00	16.67	14.28	12.50	11.11	10.53	9.75	9.32	8.89
85.00	35.41	26.56	21.25	17.71	15.18	13.28	11.80	11.18	10.36	9.88	9.44
90.00	37.50	28.12	22.50	18.75	16.07	14.06	12.50	11.84	10.97	10.48	10.00
95.00	39.58	29.69	23.75	19.79	16.43	14.84	13.19	12.50	11.58	11.04	10.55
100.00	41.67	31.25	25.00	20.83	17.86	15.62	13.89	13.16	12.19	11.63	11.11

The poorer grades of cottonseed meal or cake usually sell only a little lower than the prices for the higher-grade products. By obtaining commercial prices on both high-grade and low-grade products and referring to Table 2, one can ascertain approximately which feed will provide protein at the least cost. It must be remembered,

however, that the feeding values of different feeds having essentially the same coefficients of digestibility are not exactly proportional to their respective protein contents. A low-protein feed usually has a higher content of carbohydrates, which may partially make up in feeding value for the difference in protein content.

Good cottonseed meal contains three times as much digestible protein and as much digestible carbohydrates and fat combined as there is in wheat bran. One pound of cottonseed meal will balance as much corn as 3 pounds of bran.

Sometimes the analysis of cottonseed meal offered for sale is given on the tag in terms of nitrogen or of ammonia, or it may be quoted in those terms by feed dealers. One may readily determine the protein content by using the following factors:

Multiply the nitrogen by 6.25. For example, if the analysis is given as 6 per cent nitrogen, then the pounds of protein in 100 pounds of the meal will be 6×6.25, which is 37.50. This means that it is a good grade of meal.

If the analysis is given in terms of ammonia, multiply the per cent of ammonia by 5.15. For example, if the analysis is given as 7.5 per cent ammonia, the protein in 100 pounds of the meal will be 7.5×5.15, which is 38.62, meaning that it is a good grade of meal.

COTTONSEED PRODUCTS FOR VARIOUS CLASSES OF LIVESTOCK.

The rations given in the succeeding pages may be used as the average and may be adjusted to suit local conditions. If the suggested rations can not be used, one may substitute other feeds of the same general character as those included in the rations outlined. These rations are primarily designed to show the proper proportions in which to use cottonseed products and no attempt is made to cover all conditions.

In discussions of feeding cottonseed products, the quantities for the different classes of animals are given in pounds. While it is important to weigh the meal as fed, yet it may be entirely satisfactory merely to weigh at frequent intervals the contents of a certain measure or vessel. Table 3, giving weights and measures, may be helpful along this line.

TABLE 3.—*Equivalent weights and measures of cottonseed products.*

Product.	One quart weighs—	One pound measures—
	Pounds.	*Quarts.*
Cotton seed	0.8	1.3
Cottonseed meal	1.5	.7
Cottonseed hulls	.3	3.3

FATTENING CATTLE.

It is for fattening cattle that cottonseed concentrates serve their greatest usefulness. A very large percentage of cottonseed feeds is used for cattle fattened for market. The usual feeding period for this class of cattle is from 90 to 120 days, and during that period comparatively large quantities of cottonseed cake or meal are used. When steers are not fed more than 7 pounds of cottonseed meal a day, they can usually be fed from 100 to 120 days without showing any signs of cottonseed-meal poisoning. If silage or other succulent feed is given as roughage, the meal can be fed longer without harmful results.

When cattle are fed a ration composed only of cottonseed hulls and meal, they usually make good daily gains for the first 60 days,

FIG. 2.—These fat yearling steers, fed in West Virginia, received a ration of silage and cottonseed meal.

after which the gains diminish rapidly, and after 90 to 100 days they are seldom satisfactory. For a short feeding period cottonseed hulls and meal give satisfactory results. If the roughage is silage instead of hulls, the daily gains are more nearly uniform throughout the feeding period, and if care is used in feeding the meal it can be fed for 150 days without ill effects.

In many of the leading cattle-feeding sections of the Corn Belt cottonseed meal is used extensively, especially as a supplement to silage. Where alfalfa is grown successfully, as in the western part of the Corn Belt, little or no cottonseed meal is used. Not only has it proved to be economical for fattening cattle in the winter, but many feeders use the cake as a supplement to grass. Its use in most feeding sections is limited to 3 or 4 pounds a day for cattle averaging 1,000 pounds live weight.

One reason why cottonseed meal is highly prized for feeding cattle is that it puts on a glossy finish, which makes them sell better than

cattle having harsh, rough coats. There is also a tendency for cattle receiving cottonseed meal to put on a smooth, even covering of firm flesh.

Suggested rations for fattening steers averaging 1,000 pounds in weight.

Ration 1.	Pounds.
Corn (or sorghum) silage	25
Mixed hay	10
Corn	10
Cottonseed meal	3

Ration 2.	
Wet beet pulp	80
Prairie hay	10
Beet molasses	4
Cottonseed meal	4

Ration 3.	Pounds.
Sorghum (or kafir) silage	35
Grass hay or stover	6
Cottonseed meal or cake	4
Kafir (or milo) chops	10

Ration 4.	
Sorghum silage	30
Grass hay or stover	6
Velvet beans in pod	6
Cottonseed meal	3

STOCK CATTLE.

For stock cattle the use of cottonseed meal is ordinarily confined to the winter period, and then only in amounts sufficient to add to the ration the protein required. It is especially valuable to use in connection with cheap roughages and silages which are highly carbonaceous feeds. For stock cattle weighing 500 to 750 pounds, from 1 to 2 pounds of the meal is enough to balance properly most roughage rations. When legume hays are used the cottonseed meal may be materially reduced and sometimes entirely eliminated to advantage. If alfalfa or clover constitutes half or more of the roughage ration, there is little or no need for the use of additional protein-rich feeds.

Few combinations are more economical than a ration of corn silage and cottonseed meal for wintering stock cattle. One to two pounds of cottonseed meal combined with whatever silage stock steers will eat will keep them in good, thrifty condition and cause them to make a profitable gain. The cost of wintering such cattle can usually be lessened by permitting the steers to run in the stalk fields and giving them feed at night only. Straw and other roughages which can not be used to advantage in any other way may be fed with silage and cottonseed meal.

Suggested rations for wintering stockers averaging 750 pounds in weight.

Ration 1.	Pounds.
Corn (or sorghum) silage	25
Oat or wheat straw	Unlimited.
Cottonseed meal	½ to 1½

Ration 2.	
Corn (or sorghum) silage	25
Oats or corn	2
Cottonseed meal	½
Straw or stover	Unlimited.

Ration 3.	Pounds.
Corn stover silage	25
Grass hay	6
Cottonseed meal	½ to 1½

Ration 4.	
Cottonseed cake	1 to 1½
Silage, to supplement winter pastures	15 to 20

BREEDING CATTLE.

In feeding cottonseed meal to beef cows, two classifications may be made—dry cows and cows that nurse calves. The dry cows may be handled in much the same manner as stock cattle. The amount of cottonseed meal that should be fed to this class of cows depends on the other feeds used. Some feeders use excessive quantities of cottonseed meal, causing the cost of the ration to become uneconomically high. From 1 to 1½ pounds of cottonseed meal may be fed daily with other feeds, such as corn silage and good hay. Where corn silage is available, a good ration for breeding cows would be 25 to 30 pounds silage, from 1 to 1½ pounds cottonseed meal or cake, and other roughage, such as stalk fields, corn stover, hay, or straw.

Cows that are nursing calves should receive more protein supplements than dry cows, but the amounts fed should not be greater than is necessary to balance properly the other feeds, which may consist largely of roughages. Ordinarily beef cows raising calves are fed not more than 2 pounds each daily, and then only during the winter period.

Suggested rations for wintering beef breeding cows averaging 1,000 pounds in weight.

RATION 1.

	Pounds.
Corn silage	25 to 30
Cereal straw or stover	Unlimited.
Cottonseed meal	1 to 1½

RATION 2.

Corn (or sorghum) silage	25 to 30
Cottonseed meal	1 to 1½
Winter pasture.	

RATION 3.

	Pounds.
Grass hay or stover	18 to 20
Cottonseed meal or cake	1½ to 2

RATION 4.

Kafir (or milo) silage	30 to 35
Kafir or milo stover or cereal straw	Unlimited.
Cottonseed meal or cake	1½

CALVES.[4]

It is well not to use cottonseed meal at all until the calf is 3 to 4 months old, and then only in a limited way. By the time the calf is 1 year old it may be eating from ½ to 1½ pounds a day with comparative safety. For young calves, linseed meal is by far a better feed and is to be preferred. Contrasted with cottonseed meal, linseed meal contains no toxic substances, and the high content of mineral matter makes it especially valuable for young stock of all kinds. Cows suckling calves may be fed cottonseed meal in moderate amounts without any detrimental effect to the calves.

DAIRY COWS.

Dairy cows are often fed comparatively large quantities of cottonseed products, sometimes for long periods of time. The amount of cottonseed meal to use should be regulated partly by the production

[4] Those interested in beef production should send for Farmers' Bulletin 1135, "The Beef Calf, Its Growth and Development," and Farmers' Bulletin 1073, "Growing Beef on the Farm."

of butterfat and the nature of the other feeds used. One must remember also that cottonseed meal or cake is constipating and should be used with more laxative feeds, such as linseed meal, wheat bran, silage, or roots. When used in large quantities for dairy cows it produces hard, tallowy butter, light in color and poor in flavor. When used in moderate amounts the quality of the products need not be impaired and in many instances can be improved if the other feeds tend to produce soft butter. The cottonseed products are heavy, concentrated protein feeds and for best results should be used with lighter and more bulky feeds. For average dairy cows the use of cottonseed products should be limited to 2 or 3 pounds a day when used in connection with other concentrates.

Suggested rations for a 1,000-pound dairy cow, giving 25 pounds of 4 per cent milk daily.[5]

Ration 1.

	Pounds.
Clover hay	10
Corn (or sorghum) silage	35
Ground corn	3
Wheat bran	2
Cottonseed meal	2

Ration 2.

Roots (mangels)	20
Mixed hay	15
Corn-and-cob meal	2
Crushed barley	3
Cottonseed meal	2½

Ration 3.

	Pounds.
Barley (or oat) hay	15
Clover or alfalfa hay	5
Dried beet pulp (soaked)	5
Cottonseed meal	2

Ration 4.

Corn (or sorghum) silage	35
Grass hay	10
Corn chops	4
Cottonseed meal	2½

BULLS AND YOUNG STOCK.

It is not advisable to feed bulls more than a very limited ration of cottonseed meal; many practical stockmen say that it impairs the breeding qualities of the animal. Bulls should receive a sufficiency of protein-rich feeds, but cottonseed meal should be used only in moderate amounts. Throughout the winter it may be used for the bull to the extent of 1½ or 2 pounds along with other concentrates, such as bran, corn, and oats.

It is highly important that young stock of both beef and dairy breeds intended for breeding purposes be supplied with an abundance of protein and mineral matter. Although cottonseed products are not so valuable as linseed meal for this purpose, they are especially valuable as a source of protein. As previously stated, their use should be very limited before the calves are 4 months old, but may be increased to 1½ pounds by the time the animal is a year old.

[5] Those desiring detailed information on this subject should send for Farmers' Bulletin 743, "The Feeding of Dairy Cows."

HOGS.

As stated, hogs are especially susceptible to poisoning from cottonseed meal. Cottonseed products to the extent of one-fourth of the concentrate ration have been used for short periods of 40 days or less, frequently without harmful effects. But usually if the cottonseed meal is fed for more than 5 or 6 weeks, harmful results will follow. By decreasing the amount of meal, or by supplying pasture or other succulent feeds, the poisoning may be delayed. As yet no satisfactory way of neutralizing the poison has been found. It would be well for the experienced as well as the inexperienced swine feeder to let cottonseed meal alone and use such safe protein feeds as tankage, fish meal, linseed meal, and skim milk.

Before the use of cottonseed meal became general, cattle feeders believed that hogs following the steers in the feed lot might become poisoned. Experience has shown, however, that no detrimental results follow this practice. Evidently the toxic substances have become neutralized in the process of digestion. When the meal or cake fed to the cattle is not accessible to the pigs, there is no danger that the pigs will be poisoned by eating the waste feed in the droppings.

HORSES.

Cottonseed meal has met with considerable disfavor among horse feeders because they say it causes digestive disorders. There may be considerable truth in this statement, because many horses have been killed by the feeding of excessive quantities of cottonseed meal. In too many cases, however, the quality of cottonseed meal has not always been the best or the quantity safeguarded. Horses are very susceptible to injury from eating moldy feed and this applies particularly to the use of cottonseed products. In the South, plantation owners often feed their mules on cottonseed meal in conjunction with corn, with apparently good results. Quite often it is used in connection with blackstrap molasses and grain.

The use of cottonseed meal for horses and mules can be recommended only in limited quantities, and then care must be exercised in securing cottonseed meal of good quality. Horses should be started on the meal gradually and it should always be used as a supplement to a carbonaceous feed, such as corn. The meal is not relished by horses and, being unpalatable, it should be well incorporated with other feeds. While it has been fed in larger quantities in a few cases, the best results may be obtained by limiting the amount to 1 pound per 1,000 pounds live weight, and by giving special attention to the horses receiving the cottonseed meal.

Suggested rations for a 1,000-pound horse at medium work.

RATION 1.

	Pounds.
Oats	12
Timothy hay	10
Cottonseed meal	¾

RATION 2.

Shelled corn	10
Molasses	2
Grass hay	8
Cottonseed meal	1

RATION 3.

	Pounds.
Rolled barley	10
Oat hay	10
Cottonseed meal	¾

RATION 4.

Shelled corn	6
Wheat bran	4
Cottonseed meal	1
Timothy hay	10

SHEEP.

In feeding sheep it is highly important to balance properly the rations used. Protein-rich concentrates can be used advantageously for this purpose. Cottonseed meal and cake have been used for fattening sheep with fairly satisfactory results, but not so extensively as linseed meal. In limited quantities it may be used to advantage.

Cottonseed meal and cake are also used to advantage in limited quantities for breeding ewes. One-half pound a day meets their requirementse.

Sheep should be started on cottonseed products in small quantities. Lambs when on full feed should receive not more than one-third of a pound a day when fed no other concentrates, and only one-eighth to one-fourth of a pound in combination with other grains. It is advisable to use cottonseed meal in connection with corn, oats, or similar grain. Sheep usually relish cottonseed cake more than the finely ground meal.

Suggested rations for 60-pound fattening lambs.

RATION 1.

	Pounds.
Shelled corn	1.0
Grass hay	1.0
Cottonseed meal	.3

RATION 2.

Shelled corn	1.2
Alfalfa	.4
Corn silage	.6
Cottonseed meal	.2

RATION 3.

	Pounds.
Corn silage	1.2
Barley	1.0
Cottonseed meal	.2
Clover hay	.6

RATION 4.

Wet beet pulp	3.0
Barley	.6
Cottonseed meal	.3
Prairie hay	1.0

COTTONSEED MEAL OR CAKE FOR PASTURE FEEDING.

For years feeders, of the Southwest particularly, have used cottonseed cake for feeding steers on pasture in the fall and winter (at times when the grass was covered with snow) and also during periods of

grass shortage. The fattening of cattle on grass with cottonseed cake during the spring and summer months has during more recent years been found to be an economical practice. The cake is usually preferred to the meal for grass feeding. In regard to feeding cake in preference to meal, a former publication of the bureau is here quoted: [6]

> There are several advantages in feeding cake in place of meal, especially in summer feeding. A rain does not render the cake unpalatable, but it will often put the meal in such a condition that the cattle will not eat it. Again, no loss is incurred with the cake during windy days, whereas the meal, when fed in the open pasture, is sometimes wasted on account of the high winds. Furthermore, the cake requires chewing before being swallowed and therefore must be eaten very much slower than the meal, so when a number of steers are being fed together the greedy one has little chance to get enough cake to produce scours. When cottonseed meal is fed, the greedy steer often scours, because he can bolt the meal and get more than his share; this not only injures the steer but makes the bunch "feed out" unevenly.

In experiments conducted in the Southeast by the Bureau of Animal Industry in which the cake was fed in troughs in the pasture, it was found after several years' work that the feeding of cottonseed cake to cattle on pasture caused the cattle to fatten more rapidly, to develop greater finish, and to make greater profits in most cases than with similar cattle which received pasture alone. The value of the cake as a supplement to pasture, of course, depends to a considerable extent upon the nature of the pasture grasses, its use for legumes not being so profitable as with true grasses. As a rule, however, the feeding of cottonseed cake on good grass pasture is not highly profitable. The stage of maturity of the grass is also of significance in this connection, because dry, mature grass is of a more carbonaceous nature than grass in earlier stages of growth.

EXPERIMENTAL RESULTS SHOWING THE VALUE OF COTTONSEED PRODUCTS IN RATIONS.

VALUE OF PROTEIN SUPPLEMENT FOR STEER FEEDING.

Numerous experiments have conclusively shown the value of protein supplements when added to rations deficient in protein. The following summary covers four experiments, averaging 132 days, with 2-year-old steers, in which a nitrogenous supplement was added to a ration of corn and a carbonaceous roughage.

The addition of the protein supplement increased the average daily gain 0.60 pound a day and reduced the total concentrates required to produce 100 pounds gain from 1,082 pounds to 862 pounds and the roughage from 522 pounds to 402 pounds.

[6] From Bureau of Animal Industry Bulletin 131 "Beef Production in Alabama."

TABLE 4.—*Summary of four feeding experiments showing the value of a protein supplement.*[1]

Ration.	Number of steers.	Average daily gain.	Feed per 100 pounds gain.		
			Concentrates.		Carbonaceous roughage.
			Corn.	Protein supplement.	
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Corn and carbonaceous roughage	44	1.60	1,082	.....	522
Corn, protein supplement, and carbonaceous roughage	54	2.20	766	96	402

[1] Bulletin references: Illinois Experiment Station Bulletin 83; Indiana Experiment Station Bulletin 115; Nebraska Experiment Station Bulletins 90 and 93.

FIG. 3.—Inspecting cattle and hearing reports of experimental work at Canton, Miss. The steers were fattened largely on silage and cottonseed meal.

COTTONSEED MEAL COMPARED WITH OTHER CONCENTRATES FOR DAIRY COWS.

At the New Jersey station 4 cows were fed for 66 days on a ration of corn silage and corn stover, with either cottonseed meal alone or a mixture of equal parts of wheat bran and dried brewers' grains for the concentrate allowance, the latter being fed alternately, with the result shown in Table 5.

TABLE 5.—*Summary of feeding experiment showing relative value of cottonseed meal and other concentrates.*[1]

Feed.	Average daily yield.	
	Milk.	Butterfat.
Ration 1: *Pounds.*	*Pounds.*	*Pounds.*
Corn silage....36		
Corn stover....6	22.7	0.96
Cottonseed meal....4.5		
Ration 2:		
Corn silage....36		
Corn stover....6	23.9	0.95
Wheat bran....5		
Dried brewers' grains....5		

[1] From New Jersey Experiment Station Report for 1903.

In this experiment 4.5 pounds of cottonseed meal were found to be practically equal to 5 pounds of wheat bran and 5 pounds of dried brewers' grains. Most dairymen conclude that 1 pound of good-quality cottonseed meal is equal to 2 pounds of wheat bran for milk production.

PASTURE SUPPLEMENTED WITH COTTONSEED CAKE.

TABLE 6.—*Value of cottonseed products as a supplement to pasture in steer feeding.*[1]

Lot.	Ration.	Average daily gain.	Daily ration of concentrates.	Selling price of cattle.	Profit per steer.
		Pounds.	*Pounds.*		
Lot A	Pasture alone	1.52		$3.66	$2.86
Lot B	Pasture plus cottonseed cake	2.32	3.31	4.53	10.42

[1] From Bureau of Animal Industry Bulletin 131.

The addition of 3.31 pounds of cottonseed cake a day as a supplement to the grass increased the daily gain 0.80 pound or from 1.52 to 2.32. The use of the protein supplement increased the selling prices of the cake-fed cattle, so that they made a greater profit than the cattle receiving grass alone. (See Table 6.)

COTTONSEED MEAL AS A SUPPLEMENT TO CORN AND A CARBONACEOUS ROUGHAGE FOR FATTENING LAMBS.

In Table 7 the results of four experiments, averaging 80 days, show the effect of adding cottonseed or linseed meal to a ration of timothy hay and corn.

TABLE 7.—*Effect of cottonseed meal or linseed meal as a supplement to timothy hay and corn for lambs.*[1]

Ration.	Daily gain.	Feed for 100 pounds gain.	
		Concentrates.	Hay.
Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Corn 1.2 Timothy hay 1.0	0.23	520	448
Corn 1.2 Timothy hay 1.0 Cottonseed (or linseed) meal .2	.30	463	334

[1] From Ohio Experiment Station Bulletin 245, Minnesota Experiment Station Bulletin 31, and Indiana Experiment Station Bulletin 162.

The use of a small quantity of protein-rich concentrate increased the daily gains 30 per cent and made a saving of 57 pounds of concentrates and 114 pounds of roughage per 100 pounds gain.

LINSEED MEAL AND COTTONSEED MEAL FOR FATTENING SHEEP.

TABLE 8.—*Summaries of sheep-fattening experiments showing comparative value of linseed meal and cottonseed meal.*[1]

Ration.	Initial weight.	Daily gain.	Feed for 100 pounds gain.	
			Concentrates.	Hay.
Ohio station, 112-day trial:				
Lot 1. 40 lambs—	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Linseed meal	0.2	65	0.30	397	497
Shelled corn	1.0				
Clover or alfalfa hay	1.5				
Lot 2. 40 lambs—				
Cottonseed meal	0.2	67	.31	388	486
Shelled corn	1.0				
Clover or alfalfa hay	1.5				
Missouri station, 98-day trial:				
Lot 1. 20 yearling wethers—				
Linseed meal	0.2	79	.25	491	703
Shelled corn	1.1				
Clover hay	1.8				
Lot 2. 20 yearling wethers—				
Cottonseed meal	0.2	78	.24	511	748
Shelled corn	1.1				
Clover hay	1.8				

[1] From Ohio Experiment Station Bulletin 179 and Missouri Experiment Station Bulletin 115.

In the trials listed in Table 8 cottonseed meal and linseed meal showed substantially the same value for balancing the rations of fattening lambs and wethers. Whether to use cottonseed or linseed meal as a protein supplement for fattening sheep depends to a very large extent upon their relative prices and availability.

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FEEDING COTTONSEED PRODUCTS TO LIVESTOCK

IN REGIONS where much corn, stover, fodder, timothy, or other carbohydrate feed is used, it is important to use some feed that is high in protein, such as cottonseed meal.

Cottonseed meal stimulates the appetite of fattening animals and causes them to consume more feed and likewise to make greater gains.

Cottonseed cake or meal may be used satisfactorily as a supplemental feed for fattening beef cattle on pasture.

Cottonseed meal is a very valuable protein feed for dairy cows. One pound of good-quality cottonseed meal furnishes as much digestible protein as 3 pounds of wheat bran. Like wheat bran, cottonseed meal is high in phosphorus.

For high-producing dairy cows, however, the addition of cottonseed meal to rations of the type mentioned renders them satisfactory only so far as the protein requirement is concerned.

Hogs may be fed cottonseed meal in limited quantities as a protein supplement.

Horses may be fed cottonseed products only in small quantities and then with great caution.

Procure prices on various grades of cottonseed meal or cake and choose the feed which supplies a pound of protein at the least cost.

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FEEDING COTTONSEED PRODUCTS TO LIVESTOCK

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VALUE OF COTTONSEED PRODUCTS AS LIVESTOCK FEEDS

COTTONSEED PRODUCTS have been used extensively for stock feeding in the South for many years. During more recent times their use has become general in many sections outside the Cotton Belt. The demand from foreign countries is strong, despite the fact that these products cost considerably more there than they do in this country. European feeders, as a rule, have placed more value on high-protein feeds than the average American livestock man.

Another reason why cottonseed products are of such great importance, in addition to their high protein content, is their immense production. Although the production of cotton has shown a slight decrease during the last 10 years, the decrease has not been so marked as has been the case with flaxseed, from which linseed meal [1] is made. Several new protein feeds, like peanut cake, copra cake, and fish meal, have been offered on the market during the last few years, but with the average stockman they have not been received with so much favor as cottonseed meal or linseed meal, due in part to their unknown value. These newer products, however, have some characteristics that are making them of value in livestock feeding.

COMPOSITION OF COTTONSEED PRODUCTS

There are a large number of cottonseed products used as livestock feeds. Both concentrates and roughages are included. All the concentrate products have the same general characteristics and qualities, their chemical composition depending mainly upon the form of manufacture and the thoroughness in separating out the hulls. Among the more common cottonseed products used as feeds are cot-

[1] This product is also known as "oil meal," and "new-process" and "old-process" meal.

tonseed, cottonseed meal and cake, and cottonseed hulls. Table 1 gives analyses representing these products, which have been put on the market by manufacturers to conform to the definitions adopted by the Association of Feed Control Officials of the United States.

TABLE 1.—*Composition of cottonseed products* [1]

[Pounds of nutrients in 100 pounds]

Product	Water	Ash	Crude protein	Carbohydrates		Fat (ether extract)
				Fiber	Nitrogen-free extract	
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Cottonseed	9.1	4.0	19.6	18.9	28.3	20.1
Cottonseed meal and cake:						
41 per cent protein	7.1	5.7	41.7	10.0	28.4	7.1
38.6 per cent protein	6.9	5.9	38.8	12.2	29.4	6.8
36 per cent protein	7.3	5.8	36.8	13.5	30.0	6.6
Cold-pressed cottonseed	6.9	4.2	27.5	24.2	30.2	7.0
Cottonseed hulls	8.7	2.6	3.5	46.2	38.0	1.0

[1] Furnished by the Bureau of Chemistry, United States Department of Agriculture.

GRADES AND CLASSES OF COTTONSEED PRODUCTS

Formerly cottonseed (uncrushed) was used quite extensively as a feed for livestock. Its value as a source of cottonseed oil and its utilization for commercial purposes has greatly decreased the amount fed in the form of seed. Cottonseed products have taken the place of the seed as a feedstuff. Several feeding tests have indicated that 1 pound of good-quality cottonseed meal is equal to nearly 2 pounds of cottonseed as a feed for fattening steers. Large rations of cottonseed tend to produce scours, but when used in quantities up to 5 or 6 pounds there is little or no trouble from this source.

Cottonseed contains about 20 per cent each of fat or oil and crude protein. Compared with a good grade of cottonseed meal it contains about half as much protein and about three times the content of oil.

A ton of cottonseed will yield approximately the following quantities of products:[2]

	Pounds
Linters or short fiber	110
Hulls	514
Cake or meal	954
Crude oil	303
Dirt and loss in manufacture	119
Total	2,000

Cottonseed cake is made from the residue which remains after the oil has been extracted from the seed. Ordinarily the greater part of the hulls is removed before the oil is extracted. When this is done the amount of crude fiber in the resulting cake is proportionately smaller. The hulled kernels are crushed, heated, and subjected to great pressure to remove the oil. The residue when of prime quality should be a hard, boardlike cake of a yellowish color. The color is often an indication of the quality. The presence of hulls

[2] Average for the five years 1914–15 to 1918–19 as compiled by the Bureau of Markets, United States Department of Agriculture, from Bureau of Census figures and estimates.

gives the cake a dark appearance. A dark color may also be caused by overheating during the pressing process or by fermentation, each of which lessens the feeding value.

Cottonseed cake and cottonseed meal are practically one and the same thing; that is, the meal is the cake in a ground form. The meal is most commonly used, but the cake has a distinct advantage in certain cases. European buyers show a preference for the cake for the reasons that there is less loss in handling, it is easier to judge the quality, and because the cake is better adapted for feeding alone or on the ground. Ocean freight rates also are lower for the cake than the meal.

In the United States the cake is preferred by men who feed their cattle in the open where the wind may blow the meal away. On the range or pasture the cake is often broken up and fed in troughs or spread upon the ground. If meal were used, the loss in feeding in this manner would be very large.

There are many grades and classes of cottonseed products sold on the market. The grades as classified and described by the Association of Feed Control Officials of the United States are as follows:

Cottonseed meal is a product of the cottonseed only, composed principally of the kernel with such portion of the hull as is necessary in the manufacture of oil, provided that nothing shall be recognized as cottonseed meal that does not conform to the foregoing definition and that does not contain at least 36 per cent of protein. Cottonseed meal shall be graded and classed as follows:

1. Cottonseed meal, prime quality. Cottonseed meal, prime quality, must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color, yellowish, not brown or reddish, free from excessive lint, and shall contain not less than 36 per cent of protein. It shall be designated and sold according to its protein content. Cottonseed meal with 36 per cent of protein shall be termed "36 per cent protein cottonseed meal, prime quality," and higher grades similarly designated (as "43 per cent protein cottonseed meal, prime quality"), etc.

2. Cottonseed meal, off quality. Cottonseed meal not fulfilling the above requirements as to color, odor, and texture shall be graded "36 per cent protein cottonseed meal, off quality," and higher grades similarly designated.

Cottonseed feed is a mixture of cottonseed meal and cottonseed hulls, containing less than 36 per cent of protein.

Cold-pressed cottonseed is the product obtained from the subjection of the whole undecorticated cottonseed to the cold-pressure process for the extraction of oil and includes the entire cottonseed less the oil extracted.

Ground cold-pressed cottonseed is the product obtained by grinding cold-pressed cottonseed.

Cottonseed hulls are the roughage product of cottonseed-oil manufacture. The hulls are removed from the cottonseed before the oil is extracted. They have a very low-protein content and should be fed only in connection with protein-rich feeds. As a roughage the hulls have a lower feeding value than oat straw or corn stover, but are valuable where no other roughage is available. This product is used extensively in the South, especially for steer feeding.

Cottonseed-hull bran is ground cottonseed hulls from which the lint has been removed. The feeding value of the bran is not appreciably greater than that of ordinary cottonseed hulls.

ECONOMY OF USING HIGH-GRADE COTTONSEED PRODUCTS

Cottonseed products containing a high percentage of protein command relatively high prices, but judged from the cost of the protein contained, they are comparatively cheap. Some feeders prefer to buy the lower-grade products, believing them to be more economical

than the better grades. From the standpoint of the cost of the protein in the feeds such men are usually deceiving themselves. These products are usually purchased for their protein content and prices paid should be based on the protein contained in them. To show the value per pound of the protein in feeds at various prices and containing varying guaranteed analyses of protein, Table 2 has been prepared.

TABLE 2.—*Cost of protein per pound in feeds at various prices per ton*

Cost of feed per ton	Per cent of protein in feeds										
	12	16	20	24	28	32	36	38	41	43	45
	Cost per pound of protein										
	Cents	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*
$25.00	10.42	7.82	6.25	5.23	4.47	3.91	3.47	3.29	3.05	2.91	2.77
30.00	12.50	9.38	7.50	6.25	5.36	4.69	4.16	3.95	3.66	3.48	3.38
35.00	14.58	10.94	8.75	7.29	6.25	5.47	4.86	4.61	4.26	4.07	3.89
40.00	16.67	12.50	10.00	8.33	7.14	6.25	5.55	5.26	4.88	4.65	4.44
45.00	18.75	14.06	11.25	9.38	8.03	7.03	6.25	5.92	5.49	5.23	5.00
50.00	20.83	15.63	12.50	10.42	8.93	7.81	6.94	6.58	6.09	5.81	5.55
55.00	22.91	17.19	13.75	11.46	9.82	8.59	7.64	7.24	6.71	6.40	6.11
60.00	25.00	18.75	15.00	12.50	10.71	9.38	8.33	7.89	7.32	6.97	6.67
65.00	27.08	20.31	16.25	13.54	11.67	10.16	9.03	8.55	7.92	7.56	7.22
70.00	29.16	21.87	17.50	14.58	12.50	10.94	9.72	9.21	8.53	8.14	7.78
75.00	31.25	23.44	18.75	15.62	13.39	11.72	10.41	9.87	9.14	8.72	8.33
80.00	33.33	25.00	20.00	16.67	14.28	12.50	11.11	10.53	9.75	9.32	8.89
85.00	35.41	26.56	21.25	17.71	15.18	13.28	11.80	11.18	10.36	9.88	9.44
90.00	37.50	28.12	22.50	18.75	16.07	14.06	12.50	11.84	10.97	10.48	10.00
95.00	39.58	29.69	23.75	19.79	16.43	14.84	13.19	12.50	11.58	11.04	10.55
100.00	41.67	31.25	25.00	20.83	17.86	15.62	13.89	13.16	12.19	11.63	11.11

The poorer grades of cottonseed meal or cake usually sell only a little lower than the prices for the higher-grade products. By obtaining commercial prices on both high-grade and low-grade products and referring to Table 2, one can ascertain approximately which feed will provide protein at the least cost. It must be remembered, however, that the feeding values of different feeds having essentially the same coefficients of digestibility are not exactly proportional to their respective protein contents. A low-protein feed usually has a higher content of carbohydrates, which may partially make up in feeding value for the difference in protein content.

Good cottonseed meal contains three times as much digestible protein and as much digestible carbohydrates and fat combined as there is in wheat bran. One pound of cottonseed meal will balance as much corn as 3 pounds of bran.

Sometimes the analysis of cottonseed meal offered for sale is given on the tag in terms of nitrogen or of ammonia, or it may be quoted in those terms by feed dealers. One may readily determine the protein content by using the following factors:

Multiply the nitrogen by 6.25. For example, if the analysis is given as 6 per cent nitrogen, then the pounds of protein in 100 pounds of the meal will be 6×6.25, which is 37.50. This means that it is a good grade of meal.

If the analysis is given in terms of ammonia, multiply the per cent of ammonia by 5.15. For example, if the analysis is given as 7.5 per cent ammonia, the protein in 100 pounds of the meal will be 7.5×5.15, which is 38.62, meaning that it is a good grade of meal.

COTTONSEED PRODUCTS FOR VARIOUS CLASSES OF LIVESTOCK

The rations given in the succeeding pages may be used as the average and may be adjusted to suit local conditions. If the suggested rations can not be used, one may substitute other feeds of the same general character as those included in the rations outlined. These rations are primarily designed to show the proper proportions in which to use cottonseed products and no attempt is made to cover all conditions.

In discussions of feeding cottonseed products, the quantities for the different classes of animals are given in pounds. While it is important to weigh the meal as fed, yet it may be entirely satisfactory merely to weigh at frequent intervals the contents of a certain measure or vessel. Table 3, giving weights and measures, may be helpful along this line.

TABLE 3.—*Equivalent weights and measures of cottonseed products*

Product	1 quart weighs—	1 pound measures—
	Pounds	*Quarts*
Cottonseed	0.8	1.3
Cottonseed meal	1.5	.7
Cottonseed hulls	.3	3.3

FATTENING CATTLE

It is for fattening cattle that cottonseed concentrates serve their greatest usefulness. A very large percentage of cottonseed feeds is used for cattle fattened for market. The usual feeding period for this class of cattle is from 90 to 120 days, and during that period comparatively large quantities of cottonseed cake or meal are used. When steers are not fed more than 7 pounds of cottonseed meal a day, they can usually be fed from 100 to 120 days without showing any signs of cottonseed-meal poisoning. If silage or other succulent feed is given as roughage, the meal can be fed longer without harmful results.

When cattle are fed a ration composed only of cottonseed hulls and meal, they usually make good daily gains for the first 60 days, after which the gains diminish rapidly, and after 90 to 100 days they are seldom satisfactory. For a short feeding period cottonseed hulls and meal give satisfactory results. If the roughage is silage instead of hulls, the daily gains are more nearly uniform throughout the feeding period, and if care is used in feeding the meal it can be fed for 150 days without ill effects.

In many of the leading cattle-feeding sections of the Corn Belt cottonseed meal is used extensively, especially as a supplement to silage. (Fig. 1.) Where alfalfa is grown successfully, as in the western part of the Corn Belt, little or no cottonseed meal is used. Not only has it proved to be economical for fattening cattle in the winter, but many feeders use the cake as a supplement to grass. Its use in most feeding sections is limited to 3 or 4 pounds a day for cattle averaging 1,000 pounds live weight.

One reason why cottonseed meal is highly prized for feeding cattle is that it puts on a glossy finish, which makes them sell better than

cattle having harsh, rough coats. There is also a tendency for cattle receiving cottonseed meal to put on a smooth, even covering of firm flesh.

Suggested rations for fattening steers averaging 1,000 pounds in weight

Ration 1	Pounds
Corn (or sorgo) silage	25
Mixed hay	10
Corn	10
Cottonseed meal	3

Ration 2	Pounds
Wet beet pulp	80
Prairie hay	10
Beet molasses	4
Cottonseed meal	4

Ration 3	Pounds
Sorgo (or kafir) silage	35
Grass hay or stover	6
Cottonseed meal or cake	4
Kafir (or milo) chops	10

Ration 4	
Sorgo silage	30
Grass hay or stover	6
Velvet beans in pod	6
Cottonseed meal	3

STOCK CATTLE

For stock cattle the use of cottonseed meal is ordinarily confined to the winter period, and then only in amounts sufficient to add to

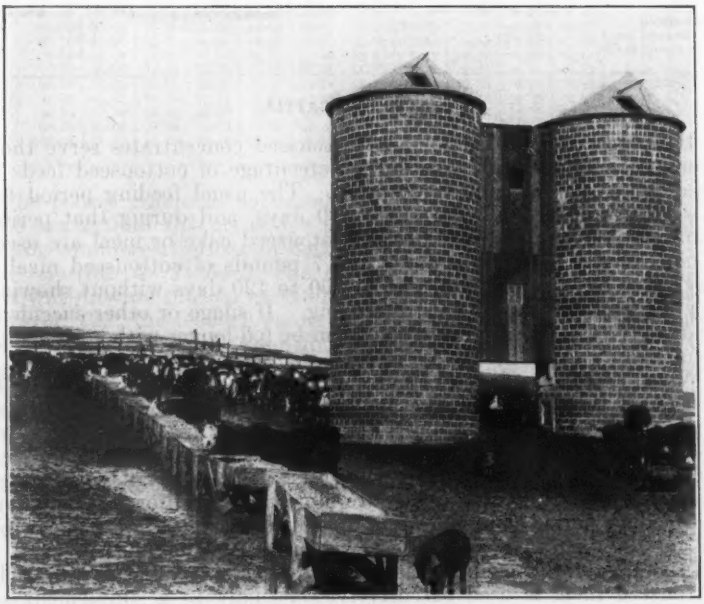

FIG. 1.—Cottonseed meal and corn silage make a good feed combination for beef cattle. The meal supplies the protein which the silage lacks

the ration the protein required. It is especially valuable to use in connection with cheap roughages and silages which are highly carbonaceous feeds. For stock cattle weighing 500 to 750 pounds, from 1 to 2 pounds of the meal is enough to balance properly most roughage rations. When legume hays are used the cottonseed meal may

be materially reduced and sometimes entirely eliminated to advantage. If alfalfa or clover constitutes half or more of the roughage ration, there is little or no need for the use of additional protein-rich feeds.

Few combinations are more economical than a ration of corn silage and cottonseed meal for wintering stock cattle. One to two pounds of cottonseed meal combined with whatever silage stock steers will eat should keep them in good, thrifty condition and cause them to make a satisfactory gain. The cost of wintering such cattle can usually be lessened by permitting the steers to run in the stalk fields and giving them feed at night only. Straw and other roughages which can not be used to advantage in any other way may be fed with silage and cottonseed meal.

Suggested rations for wintering stockers averaging 750 pounds in weight

Ration 1	Pounds
Corn (or sorgo) silage	25
Oats or wheat straw	Unlimited.
Cottonseed meal	½ to 1½

Ration 2	
Corn (or sorgo) silage	25
Oats or corn	2
Cottonseed meal	½
Straw or stover	Unlimited.

Ration 3	Pounds
Corn-stover silage	25
Grass hay	6
Cottonseed meal	½ to 1½

Ration 4	
Cottonseed cake	1 to 1½
Silage, to supplement winter pastures	15 to 20

BREEDING CATTLE

In feeding cottonseed meal to beef cows, two classifications may be made—dry cows and cows that nurse calves. The dry cows may be handled in much the same manner as stock cattle. The amount of cottonseed meal that should be fed to this class of cows depends on the other feeds used. Some feeders use excessive quantities of cottonseed meal, causing the cost of the ration to become uneconomically high. From 1 to 1½ pounds of cottonseed meal may be fed daily with other feeds, such as corn silage and good hay. Where corn silage is available, a good ration for breeding cows would be 25 to 30 pounds silage, from 1 to 1½ pounds cottonseed meal or cake, and other roughage, such as stalk fields, corn stover, hay, or straw.

Cows that are nursing calves should receive more protein supplements than dry cows, but the amounts fed should not be greater than is necessary to balance properly the other feeds, which may consist largely of roughages. Ordinarily beef cows raising calves are fed not more than 2 pounds each daily, and then only during the winter period.

Suggested rations for wintering beef-breeding cows averaging 1,000 pounds in weight

Ration 1	Pounds
Corn silage	25 to 30
Cereal straw or stover	Unlimited.
Cottonseed meal	1 to 1½

Ration 2	
Corn (or sorgo) silage	25 to 30
Cottonseed meal	1 to 1½
Winter pasture.	

Ration 3	Pounds
Grass hay or stover	18 to 20
Cottonseed meal or cake	1½ to 2

Ration 4	
Kafir (or milo) silage	30 to 35
Kafir or milo stover or cereal straw	Unlimited.
Cottonseed meal or cake	1½

XUM

DAIRY COWS

Dairy cows are often fed comparatively large quantities of cottonseed products, sometimes for long periods of time. Cottonseed meal is a valuable supplement to dairy rations which are complete in every respect except their protein content. The special value of cottonseed meal depends on its protein content. The amount of it to use should be regulated partly by the production of butterfat and the nature of the other feeds used.

One must remember also that cottonseed meal or cake is constipating and should be used with more laxative feeds, such as linseed meal, wheat bran, silage, or roots. When used in large quantities for dairy cows it produces hard, tallowy butter, light in color and poor in flavor. When used in moderate amounts the quality of the products need not be impaired and in many instances can be improved if the other feeds tend to produce soft butter. The cottonseed products are heavy, concentrated protein feeds and for best results should be used with lighter and more bulky feeds. For average dairy cows the quantity of cottonseed meal should be limited to 25 per cent of the grain mixture and in no case should exceed 4 pounds a day. All dairy rations should contain, if possible, some good-quality legume hay or legume pasture, especially in the case of high-producing cows.

Suggested rations for a 1,000-pound dairy cow, giving 25 pounds of 4 per cent milk daily

Ration 1	Pounds
Clover hay	10
Corn (or sorgo) silage	35
Ground corn	3
Wheat bran	2
Cottonseed meal	2

Ration 2	
Roots (mangels)	40
Mixed hay	15
Corn-and-cob meal	2
Crushed barley	3
Cottonseed meal	2½

Ration 3	Pounds
Barley (or oat) hay	15
Clover or alfalfa hay	5
Dried beet pulp (soaked)	6
Cottonseed meal	3

Ration 4	
Corn (or sorgo) silage	35
Grass hay	10
Corn chops	4
Cottonseed meal	3

BULLS AND YOUNG STOCK

Bulls should receive a liberal quantity of protein-rich feeds. Cottonseed meal or cake may be used for the bull to the extent of from 2 to 4 pounds, with other concentrates, such as bran, corn, and oats.

It is highly important that young stock of both beef and dairy breeds intended for breeding purposes be supplied with an abundance of protein and mineral matter. However, it may not be advisable to feed calves up to 6 months of age more than one-half pound per head per day. Calves at 1 year of age may be fed up to 2½ pounds.

HOGS

Cottonseed meal may be fed safely to hogs to the extent of 12 per cent of the total ration. The most economical method of feeding it, however, is to mix it with tankage, linseed meal, or alfalfa meal, and then not to exceed 50 per cent of such mixture.

Before the use of cottonseed meal became general, cattle feeders believed that hogs following the steers in the feed lot might become poisoned. Experience has shown, however, that no detrimental results follow this practice. Evidently the toxic substances have become neutralized in the process of digestion. When the meal or cake fed to the cattle is not accessible to the pigs, there is no danger that the pigs will be poisoned by eating the waste feed in the droppings.

HORSES

The use of cottonseed meal for horses and mules is recommended only in limited quantities, and then care must be exercised in securing cottonseed meal of good quality.

Cottonseed meal has met with considerable disfavor among horse feeders because they say it causes digestive disorders. There may be considerable truth in this statement, because many horses have been killed by the feeding of excessive quantities of cottonseed meal. In too many cases, however, the quality has not always been the best or the quantity safeguarded. Horses are very susceptible to injury from eating moldy feed and this applies particularly to the use of cottonseed products. In the South, plantation owners often feed their mules on cottonseed meal in conjunction with corn with apparently good results. Often it is used in connection with blackstrap molasses and grain.

The meal should be given to horses gradually at first and it should always be used as a supplement to a carbonaceous feed, such as corn. The meal is not relished by horses and, being unpalatable, it should be well incorporated with other feeds. While it has been fed in larger quantities in a few cases, the best results may be obtained by limiting the amount to 1 pound per 1,000 pounds live weight and by giving special attention to the horses receiving the cottonseed meal.

Suggested rations for a 1,000-pound horse at medium work

Ration 1	Pounds
Oats	12
Timothy hay	12
Cottonseed meal	¾

Ration 2	
Shelled corn (dent)	8
Wheat bran	4
Mixed timothy and clover hay	10
Cottonseed meal	¾

Ration 3	Pounds
Rolled barley	10
Oat hay	12
Cottonseed meal	1

Ration 4	
Shelled corn (dent)	9
Molasses (cane)	2
Cowpea hay	6
Sorgo fodder	6
Cottonseed meal	1

SHEEP

In feeding sheep it is highly important to balance properly the rations used. Protein-rich concentrates can be used advantageously for this purpose. (Fig. 2.) Cottonseed meal and cake have been used for fattening sheep with fairly satisfactory results. In limited quantities they may be used advantageously.

Cottonseed meal and cake are also used to advantage in limited quantities for breeding ewes. One-half pound a day meets their requirements.

Sheep should be started on cottonseed products in small quantities. Lambs when on full feed should receive not more than one-third of a pound a day when fed no other concentrates, and only one-eighth to one-fourth of a pound in combination with other grains. It is advis-

FIG. 2.—Best carload of grade lambs from range ewes at the 1925 International Livestock Exposition. Fed and exhibited by Purdue University Agricultural Experiment Station. These lambs received a ration consisting, by weight, of seven parts of corn and one part of cottonseed meal fed with corn silage and clover hay

able to use cottonseed meal in connection with corn, oats, or similar grain. Sheep usually relish cottonseed cake more than the finely ground meal.

Suggested rations for 60-pound fattening lambs

RATION 1	Pounds
Shelled corn	1.0
Grass hay	1.0
Cottonseed meal	.25

RATION 2	Pounds
Shelled corn	1.2
Alfalfa	.4
Corn silage	.6
Cottonseed meal	.2

RATION 3	Pounds
Corn silage	1.2
Barley	1.0
Cottonseed meal	.2
Clover hay	.6

RATION 4	Pounds
Barley	.6
Wet beet pulp	3.0
Cottonseed meal	.25
Prairie hay	1.0

POULTRY

Cottonseed meal is a fair poultry feed and may often be used economically in poultry rations in sections where it is produced. Vegetable protein feeds do not give as good results with poultry as animal-protein feeds and should always be supplemented with animal proteins as well as with minerals. The following mash for laying hens contains cottonseed meal supplemented with meat scraps and minerals:

	Pounds		Pounds
Yellow corn meal	35	Alfalfa leaf meal	5
Middlings	20	Bone meal	5
Cottonseed meal	10	Ground limestone	2
Meat scraps	12	Salt	1
Bran	10		

This mash should be fed with a good scratch ration which may be made up of the following ingredients, by weight: 2 parts yellow corn, 1 part wheat, and 1 part oats, or 2 parts corn and 1 part wheat.

COTTONSEED MEAL OR CAKE FOR PASTURE FEEDING

For years feeders, of the Southwest particularly, have used 1 to 2 pounds of cottonseed cake for feeding cows and steers on range in the fall and winter. Somewhat more cottonseed cake or some roughage as suggested on pages 6 and 7 should be fed when the grass is covered with snow and also during periods of grass shortage. The fattening of cattle on grass with cottonseed cake during the spring and summer months has during more recent years been found to be an economical practice. The cake is usually preferred to the meal for grass feeding. In regard to feeding cake in preference to meal, a former publication of the bureau is here quoted.[3]

> There are several advantages in feeding cake in place of meal, especially in summer feeding. A rain does not render the cake unpalatable, but it will often put the meal in such a condition that the cattle will not eat it. Again, no loss is incurred with the cake during windy days, whereas the meal, when fed in the open pasture, is sometimes wasted on account of the high winds. Furthermore, the cake requires chewing before being swallowed and therefore must be eaten very much slower than the meal, so when a number of steers are being fed together the greedy one has little chance to get enough cake to produce scours. When cottonseed meal is fed, the greedy steer often scours, because he can bolt the meal and get more than his share; this not only injures the steer but makes the bunch "feed out" unevenly.

In experiments conducted in the Southeast by the Bureau of Animal Industry in which the cake was fed in troughs in the pasture, it was found after several years' work that the feeding of cottonseed cake to cattle on pasture caused the cattle to fatten more rapidly, to develop greater finish, and to make greater profits in most cases than with similar cattle which received pasture alone. The value of the cake as a supplement to pasture, of course, depends to a considerable extent upon the nature of the pasture grasses, its use for legumes not being so profitable as with true grasses. As a rule, however, the feeding of cottonseed cake on good grass pasture is not highly profitable. The stage of maturity of the grass is also of significance in this connection, because dry, mature grass is of a more carbonaceous nature than grass in earlier stages of growth.

EXPERIMENTAL RESULTS SHOWING THE VALUE OF COTTONSEED PRODUCTS IN RATIONS

VALUE OF PROTEIN SUPPLEMENT FOR STEER FEEDING

Numerous experiments have conclusively shown the value of protein supplements when added to rations deficient in protein. The following summary covers four experiments, averaging 132

[3] GRAY, DAN T., and WARD, W. F. BEEF PRODUCTION IN ALABAMA. Bur. An. Ind. Bull. 131, 47 p., illus., 1911.

days, with 2-year-old steers, in which a nitrogenous supplement was added to a ration of corn and a carbonaceous roughage.

The addition of the protein supplement increased the average daily gain 0.6 pound a day and reduced the total concentrates required to produce 100 pounds gain from 1,082 pounds to 862 pounds and the roughage from 522 pounds to 402 pounds.

TABLE 4.—*Summary of four feeding experiments showing the value of a protein supplement* [1]

Ration	Number of steers	Average daily gain	Feed per 100 pounds gain		
			Concentrates		Carbonaceous roughage
			Corn	Protein supplement	
		Pounds	*Pounds*	*Pounds*	*Pounds*
Corn and carbonaceous roughage	44	1.60	1,082		522
Corn, protein supplement, and carbonaceous roughage	54	2.20	766	96	402

[1] Bulletin references: Ill. Expt. Sta. Bull. 83; Ind. Expt. Sta. Bull. 115; Nebr. Expt. Sta. Bulls. 90 and 93.

COTTONSEED MEAL COMPARED WITH OTHER CONCENTRATES FOR DAIRY COWS

Many experiment stations have fed cottonseed meal to dairy cows in order to compare it with other protein feeds. A condensed statement of the results obtained is shown in Table 5.

TABLE 5.—*Results of feeding experiments showing relative value of cottonseed meal and other concentrates*

Station	Feed with which compared	Result
Florida	Velvet beans in pod	Cottonseed meal worth from 1.5 to 2.5 times as much.
Maine	Gluten meal	Cottonseed meal superior.
Massachusetts	do	Do.
Do	Ground soy beans	Practically the same.
Mississippi	Cottonseed	Cottonseed meal superior.
Do	do	1 pound cottonseed meal is equal to 1.71 pounds cottonseed.
Do	Velvet beans in pod	3 pounds velvet beans superior to 2 pounds cottonseed meal.
New Jersey	Equal parts wheat bran and dried brewers' grains.	4.5 pounds cottonseed meal are practically equal to 10 pounds of the other feeds.
Do	Ground soy beans	Practically the same.
Pennsylvania	Wheat bran	Cottonseed meal increased yield about 20 per cent.
South Carolina	Velvet- bean meal	Cottonseed meal slightly superior.
Do	Wheat bran	1.5 pounds cottonseed meal slightly superior to 3 pounds wheat bran.
Tennessee	Ground soy beans	Practically the same.
United States Department of Agriculture.	Fish meal	1 pound fish meal is equal to 1.24 pounds cottonseed meal.
Do	Peanut feed	1 pound cottonseed meal is equal to 1.36 pounds peanut feed.
Do	Velvet-bean meal	1 pound cottonseed meal is equal to 1.54 pounds velvet-bean meal.

Cottonseed meal is higher in protein than any other feed with which a comparison was made with the exception of fish meal. It will be noted in Table 5 that in no case did a feed containing a smaller

percentage of protein than the cottonseed meal prove better than cottonseed meal. In this comparison the only feed showing results superior to those obtained from cottonseed meal was fish meal.

PASTURE SUPPLEMENTED WITH COTTONSEED CAKE

TABLE 6.—*Value of cottonseed products as a supplement to pasture in steer feeding* [1]

Lot	Ration	Average daily gain	Daily ration of concentrates	Selling price of cattle	Profit per steer
		Pounds	*Pounds*		
Lot A	Pasture alone	1.52		$3.66	$2.86
Lot B	Pasture plus cottonseed cake	2.32	3.31	4.53	10.42

[1] From Bureau of Animal Industry Bulletin 131.

The addition of 3.31 pounds of cottonseed cake a day as a supplement to the grass increased the daily gain 0.80 pound, or from 1.52 to 2.32 pounds. The use of the protein supplement increased the selling prices of the cake-fed cattle, so that they made a much greater profit than the cattle receiving grass alone.

COTTONSEED MEAL AS A SUPPLEMENT TO CORN AND A CARBONACEOUS ROUGHAGE FOR FATTENING LAMBS

In Table 7 the results of four experiments, averaging 80 days, show the effect of adding cottonseed or linseed meal to a ration of timothy hay and corn.

TABLE 7.—*Effect of cottonseed meal or linseed meal as a supplement to timothy hay and corn for lambs* [1]

Ration	Daily gain	Feed for 100 pounds gain	
		Concentrates	Hay
Pounds	*Pounds*	*Pounds*	*Pounds*
Corn 1.2 Timothy hay 1.0	0.23	520	448
Corn 1.2 Timothy hay 1.0 Cottonseed (or linseed) meal .2	.30	463	334

[1] From Ohio Exp. Sta. Bull. 245, Minn. Exp. Sta. Bull. 31, and Ind. Exp. Station Bull. 162.

The use of a small quantity of protein-rich concentrate increased the daily gains 30 per cent and made a saving of 57 pounds of concentrates and 114 pounds of roughage per 100 pounds gain.

LINSEED MEAL AND COTTONSEED MEAL FOR FATTENING SHEEP

TABLE 8.—*Summaries of sheep-fattening experiments showing comparative value of linseed meal and cottonseed meal* [1]

Ration	Initial weight	Daily gain	Feed for 100 pounds gain	
			Concentrates	Hay
Ohio station, 112-day trial:				
Lot 1. 40 lambs—	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Linseed meal 0.2 Shelled corn 1.0 Clover or alfalfa hay 1.5	65	0.30	397	497
Lot 2. 40 lambs—				
Cottonseed meal 0.2 Shelled corn 1.0 Clover or alfalfa hay 1.5	67	.31	388	486
Missouri station, 98-day trial:				
Lot 1. 20 yearling wethers—				
Linseed meal 0.2 Shelled corn 1.1 Clover hay 1.8	79	.25	491	703
Lot 2. 20 yearling wethers—				
Cottonseed meal 0.2 Shelled corn 1.1 Clover hay 1.8	78	.24	511	748

[1] From Ohio Expt. Sta. Bull. 179 and Mo. Expt. Sta. Bull. 115.

In the trials listed in Table 8 cottonseed meal and linseed meal showed substantially the same value for balancing the rations of fattening lambs and wethers. Whether to use cottonseed or linseed meal as a protein supplement for fattening sheep depends to a very large extent upon their relative prices and availability.

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FEEDING COTTONSEED PRODUCTS TO LIVESTOCK

BUREAU OF
U. S. DEPARTMENT OF AGRICULTURE

COTTON DIVISION COPY

IN REGIONS where much corn, stover, fodder, timothy, or other carbohydrate feed is used, it is important to use some feed that is high in protein, such as cottonseed meal.

Cottonseed meal stimulates the appetite of fattening animals and causes them to consume more feed and likewise to make greater gains.

Cottonseed cake or meal may be used satisfactorily as a supplemental feed for fattening beef cattle on pasture.

Cottonseed meal is a very valuable protein feed for dairy cows. One pound of good-quality cottonseed meal furnishes as much digestible protein as 3 pounds of wheat bran. Like wheat bran, cottonseed meal is high in phosphorus.

For high-producing dairy cows, however, the addition of cottonseed meal to rations of the type mentioned renders them satisfactory only so far as the protein requirement is concerned.

Hogs may be fed cottonseed meal in limited quantities as a protein supplement.

Horses may be fed cottonseed products only in small quantities and then with great caution.

Procure prices on various grades of cottonseed meal or cake and choose the feed which supplies a pound of protein at the least cost.

Washington, D. C.

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FEEDING COTTONSEED PRODUCTS TO LIVESTOCK

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VALUE OF COTTONSEED PRODUCTS AS LIVESTOCK FEEDS

COTTONSEED PRODUCTS have been used extensively for stock feeding in the South for many years. During more recent times their use has become general in many sections outside the Cotton Belt. The demand from foreign countries is strong, despite the fact that these products cost considerably more there than they do in this country. European feeders, as a rule, have placed more value on high-protein feeds than the average American livestock man.

Another reason why cottonseed products are of such great importance, in addition to their high protein content, is their immense production. Several new protein feeds, like peanut cake, copra cake, and fish meal, have been offered on the market during the last few years, but with the average stockman they have not been received with so much favor as cottonseed meal or linseed meal, due in part to their unknown value. These newer products, however, have some characteristics that are making them of value in livestock feeding.

COMPOSITION OF COTTONSEED PRODUCTS

Many cottonseed products are used as livestock feeds. Both concentrates and roughages are included. All the concentrate products have the same general characteristics and qualities, their chemical composition depending mainly on the form of manufacture and the thoroughness in separating out the hulls. Among the more common cottonseed products used as feeds are cottonseed, cottonseed meal and cake, and cottonseed hulls. Table 1 gives analyses representing these products, which have been put on the market by manufacturers to conform to the definitions adopted by the Association of Feed Control Officials of the United States.

[1] Died October 6, 1924.

TABLE 1.—*Composition of cottonseed products* [1]

[Pounds of nutrients in 100 pounds]

Product	Water	Ash	Crude protein	Carbohydrates		Fat (ether extract)
				Fiber	Nitrogen-free extract	
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Cottonseed	9.1	4.0	19.6	18.9	28.3	20.1
Cottonseed meal and cake:						
41 per cent protein	7.1	5.7	41.7	10.0	28.4	7.1
38.6 per cent protein	6.9	5.9	38.8	12.2	29.4	6.8
36 per cent protein	7.3	5.8	36.8	13.5	30.0	6.6
Cold-pressed cottonseed	6.9	4.2	27.5	24.2	30.2	7.0
Cottonseed hulls	8.7	2.6	3.5	46.2	38.0	1.0

[1] Furnished by the Bureau of Chemistry and Soils, United States Department of Agriculture.

Untreated cottonseed is known to contain a substance called gossypol, which is toxic to animals. This substance is made inactive by cooking the seed after the addition of water. Similarly, the cooking and expelling processes to which cottonseed meal is subjected in order to remove the oil are in a large measure destructive to the toxic principle in the raw seed. The extent to which each step in the varied methods of manufacture of cottonseed oil and cottonseed meal affects the toxicity of the meal is not yet determined, and it is possible, when this knowledge is obtained and applied, that the meal can be fed economically in larger quantities than at present.

GRADES AND CLASSES OF COTTONSEED PRODUCTS

Formerly cottonseed (uncrushed) was used quite extensively as a feed for livestock. Its value as a source of cottonseed oil and its utilization for commercial purposes have greatly decreased the amount fed in the form of seed. Cottonseed products have taken the place of the seed as a feedstuff. Several feeding tests have indicated that 1 pound of good-quality cottonseed meal is equal to nearly 2 pounds of cottonseed as a feed for fattening steers. Large rations of cottonseed tend to produce scours, but when used in quantities up to 5 or 6 pounds there is little or no trouble from this source.

Cottonseed contains about 20 per cent each of fat or oil and crude protein. Compared with a good grade of cottonseed meal it contains about half as much protein and about three times the content of oil.

A ton of cottonseed will yield approximately the following quantities of products:[2]

	Pounds
Linters or short fiber	110
Hulls	514
Cake or meal	954
Crude oil	303
Dirt and loss in manufacture	119
Total	2,000

Cottonseed cake is made from the residue which remains after the oil has been extracted from the seed. Ordinarily the greater

[2] Average for the five years 1914–15 to 1918–19 as compiled by the Bureau of Markets, United States Department of Agriculture, from Bureau of Census figures and estimates.

part of the hulls is removed before the oil is extracted. When this is done the amount of crude fiber in the resulting cake is proportionately smaller. The hulled kernels are crushed, heated, and subjected to great pressure to remove the oil. The residue when of prime quality should be a hard, boardlike cake of a yellowish color. The color is often an indication of the quality. The presence of hulls gives the cake a dark appearance. A dark color may also be caused by overheating during the pressing process or by fermentation, each of which lessens the feeding value.

Cottonseed cake and cottonseed meal are practically one and the same thing; that is, the meal is the cake in a ground form. The meal is most commonly used, but the cake has a distinct advantage in certain cases. European buyers show a preference for the cake for the reasons that there is less loss in handling, it is easier to judge the quality, and it is better adapted for feeding alone or on the ground. Ocean freight rates also are lower for the cake than for the meal.

In the United States the cake is preferred by men who feed their cattle in the open where the wind may blow the meal away. On the range or pasture the cake is often broken up and fed in troughs or spread on the ground. If meal were used, the loss in feeding in this manner would be very large.

Many grades and classes of cottonseed products are sold on the market. The grades as classified and described by the Association of Feed Control Officials of the United States are as follows:

Cottonseed meal is a product of the cottonseed only, composed principally of the kernel with such portion of the hull as is necessary in the manufacture of oil, provided that nothing shall be recognized as cottonseed meal that does not conform to the foregoing definition and that does not contain at least 36 per cent of protein. Cottonseed meal shall be graded and classed as follows:

1. Cottonseed meal, prime quality. Cottonseed meal, prime quality, must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color, yellowish, not brown or reddish, free from excessive lint, and shall contain not less than 36 per cent of protein. It shall be designated and sold according to its protein content. Cottonseed meal with 36 per cent of protein shall be termed "36 per cent protein cottonseed meal, prime quality," and higher grades similarly designated (as "43 per cent protein cottonseed meal, prime quality"), etc.

2. Cottonseed meal, off quality. Cottonseed meal not fulfilling the above requirements as to color, odor, and texture shall be graded "36 per cent protein cottonseed meal, off quality," and higher grades similarly designated.

Cottonseed feed is a mixture of cottonseed meal and cottonseed hulls, containing less than 36 per cent of protein.

Cold-pressed cottonseed is the product obtained from the subjection of the whole undecorticated cottonseed to the cold-pressure process for the extraction of oil and includes the entire cottonseed less the oil extracted.

Ground, cold-pressed cottonseed is the product obtained by grinding cold-pressed cottonseed.

Cottonseed hulls are the roughage product of cottonseed-oil manufacture. The hulls are removed from the cottonseed before the oil is extracted. They have a very low-protein content and should be fed only in connection with protein-rich feeds. As a roughage the hulls have a lower feeding value than oat straw or corn stover, but are valuable where no other roughage is available. This product is used extensively in the South, especially for steer feeding.

Cottonseed-hull bran is ground cottonseed hulls from which the lint has been removed. The feeding value of the bran is not appreciably greater than that of ordinary cottonseed hulls.

XUM

ECONOMY OF USING HIGH-GRADE COTTONSEED PRODUCTS

Cottonseed products containing a high percentage of protein command relatively high prices, but judged from the cost of the protein contained, they are comparatively cheap. Some feeders prefer to buy the lower-grade products, believing them to be more economical than the better grades. From the standpoint of the cost of the protein in the feeds such men are usually deceiving themselves. These products are usually purchased for their protein content, and prices paid should be based on the protein contained in them. To show the value per pound of the protein in feeds at various prices and containing varying guaranteed analyses of protein, Table 2 has been prepared.

TABLE 2.—*Cost of protein per pound in feeds at various prices per ton*

Cost of feed per ton	Per cent of protein in feeds										
	12	16	20	24	28	32	36	38	41	43	45
	Cost per pound of protein										
	Cents	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*
$25.00	10.42	7.82	6.25	5.23	4.47	3.91	3.47	3.29	3.05	2.91	2.77
30.00	12.50	9.38	7.50	6.25	5.36	4.69	4.16	3.95	3.66	3.48	3.38
35.00	14.58	10.94	8.75	7.29	6.25	5.47	4.86	4.61	4.26	4.07	3.89
40.00	16.67	12.50	10.00	8.33	7.14	6.25	5.55	5.26	4.88	4.65	4.44
45.00	18.75	14.06	11.25	9.38	8.03	7.03	6.25	5.92	5.49	5.23	5.00
50.00	20.83	15.63	12.50	10.42	8.93	7.81	6.94	6.58	6.09	5.81	5.55
55.00	22.91	17.19	13.75	11.46	9.82	8.59	7.64	7.24	6.71	6.40	6.11
60.00	25.00	18.75	15.00	12.50	10.71	9.38	8.33	7.89	7.32	6.97	6.67
65.00	27.08	20.31	16.25	13.54	11.67	10.16	9.03	8.55	7.92	7.56	7.22
70.00	29.16	21.87	17.50	14.58	12.50	10.94	9.72	9.21	8.53	8.14	7.78
75.00	31.25	23.44	18.75	15.62	13.39	11.72	10.41	9.87	9.14	8.72	8.33
80.00	33.33	25.00	20.00	16.67	14.28	12.50	11.11	10.53	9.75	9.32	8.89
85.00	35.41	26.56	21.25	17.71	15.18	13.28	11.80	11.18	10.36	9.88	9.44
90.00	37.50	28.12	22.50	18.75	16.07	14.06	12.50	11.84	10.97	10.48	10.00
95.00	39.58	29.69	23.75	19.79	16.43	14.84	13.19	12.50	11.58	11.04	10.55
100.00	41.67	31.25	25.00	20.83	17.86	15.62	13.89	13.16	12.19	11.63	11.11

The poorer grades of cottonseed meal or cake usually sell only a little lower than the prices for the higher-grade products. By obtaining commercial prices on both high-grade and low-grade products and referring to Table 2, one can ascertain approximately which feed will provide protein at the least cost. It must be remembered, however, that the feeding values of different feeds having essentially the same coefficients of digestibility are not exactly proportional to their respective protein contents. A low-protein feed usually has a higher content of carbohydrates, which may partially make up in feeding value for the difference in protein content.

Good cottonseed meal contains three times as much digestible protein and as much digestible carbohydrates and fat combined as there is in wheat bran. One pound of cottonseed meal will balance as much corn as 3 pounds of bran.

Sometimes the analysis of cottonseed meal offered for sale is given on the tag in terms of nitrogen or of ammonia, or it may be quoted in those terms by feed dealers. One may readily determine the protein content by using the following factors:

Multiply the nitrogen by 6.25. For example, if the analysis is given as 6 per cent nitrogen, then the pounds of protein in 100 pounds

of the meal will be 6×6.25, which is 37.50. This means that it is a good grade of meal.

If the analysis is given in terms of ammonia, multiply the per cent of ammonia by 5.15. For example, if the analysis is given as 7.5 per cent ammonia, the protein in 100 pounds of the meal will be 7.5×5.15, which is 38.62, meaning that it is a good grade of meal.

COTTONSEED PRODUCTS FOR VARIOUS CLASSES OF LIVESTOCK

The rations given in the succeeding pages may be used as the average and may be adjusted to suit local conditions. If the suggested rations can not be used, one may substitute other feeds of the same general character as those included in the rations outlined. These rations are primarily designed to show the proper proportions in which to use cottonseed products and no attempt is made to cover all conditions.

In discussions of feeding cottonseed products, the quantities for the different classes of animals are given in pounds. While it is important to weigh the meal as fed, yet it may be entirely satisfactory merely to weigh at frequent intervals the contents of a certain measure or vessel. Table 3, giving weights and measures, may be helpful along this line.

TABLE 3.—*Equivalent weights and measures of cottonseed products*

Product	1 quart weighs—	1 pound measures—
	Pounds	*Quarts*
Cottonseed	0.8	1.3
Cottonseed meal	1.5	.7
Cottonseed hulls	.3	3.3

FATTENING CATTLE IN THE DRY LOT

Fattening or carbohydrate feeds should be fed in conjunction with roughages and supplemented with feeds rich in protein. In many of the fattening areas the protein supply is limited, and accordingly is one of the factors of most importance to the cattle feeder. When there is an abundance of legume hay, such as clover or alfalfa, and its market value is not excessive, it is perhaps unnecessary to supply any additional protein in the form of a meal or cake. However, when protein can be supplied more cheaply in the latter form, it may be advisable to replace part of the hay with a meal or cake.

Protein concentrates, such as cottonseed meal or cake, are used generally in rations in which straw, stovers, or silage makes up the roughage. In buying cottonseed products as a source of protein it is usually advisable to purchase the feed that will supply protein most cheaply. This can be easily determined if the percentage of protein and price per ton are known. Cottonseed meal having a protein content of 45 per cent and priced at $45 a ton will supply protein more cheaply than 41 per cent meal at $40 a ton. (Table 2.) Generally speaking, the higher grades of a certain feed are the most reasonable sources of protein.

In many sections of the South there is a shortage of carbohydrate feeds (grains) for fattening purposes, and under these conditions considerable quantities of cottonseed hulls are fed in conjunction with cottonseed meal. This type of ration is more adaptable to cattle 2 years old and over, and for short feeding periods.

Suggested rations for fattening steers averaging 1,000 pounds in weight

Ration 1	Pounds
Corn or barley (ground)	20
Mixed hay	10
Cottonseed meal	3

Ration 2	
Corn	18
Mixed hay	5
Corn silage	20
Cottonseed meal	4

Ration 3	Pounds
Kafir or other grain sorghums	20
Sorgo fodder	15
Cottonseed meal or cake	4

Ration 4	
Molasses	3
Cottonseed hulls	25
Cottonseed meal	7

FATTENING CATTLE ON GRASS

Cottonseed products are used liberally as supplements in the fattening of cattle on grass. Cottonseed cake is frequently used as the sole supplemental feed, but more often cottonseed meal or cake is used in a mixture with corn or other grain. A desirable mixture for use as a supplement for cattle on grass is 8 parts by weight of corn or other grain and 2 parts of cottonseed meal or cake. Cattle fattened on grass with a supplement are usually allowed all the feed they will eat once a day in addition to grass. Usually cattle on pasture will not eat more than one-half the feed that would ordinarily be eaten in dry-lot feeding.

STOCK CATTLE

For stock cattle the use of cottonseed meal is ordinarily confined to the winter period, and then only in amounts sufficient to supply the necessary protein. It is especially valuable to use in connection with cheap roughages and silages. For stock cattle weighing from 500 to 750 pounds, from 1 to 2 pounds of the meal is enough to balance most roughage rations properly. If legume hays, such as alfalfa or clover, constitute half or more of the roughage ration, there is little or no need of the use of cottonseed meal.

Few combinations are more economical than a ration of corn silage and cottonseed meal for wintering stock cattle. One to two pounds of cottonseed meal combined with whatever silage stock cattle will eat should keep them in good, thrifty condition and cause them to make a satisfactory gain. The cost of wintering such cattle can usually be lessened by permitting them to run in the stalk fields and giving them feed at night only. Straw and other roughages which can not be used to advantage in any other way may be fed with silage and cottonseed meal.

Suggested rations for wintering stockers averaging 750 pounds in weight

RATION 1

	Pounds
Corn (or sorgo) silage	25
Oat or wheat straw	Unlimited.
Cottonseed meal	½ to 1½

RATION 2

Corn (or sorgo) silage	25
Oats or corn	2
Cottonseed meal	½
Straw or stover	Unlimited.

RATION 3

	Pounds
Cottonseed hulls	15 to 20
Grass hay	5
Cottonseed meal	2

RATION 4

Cottonseed cake	1 to 1½
Silage, to supplement winter pastures	15 to 20

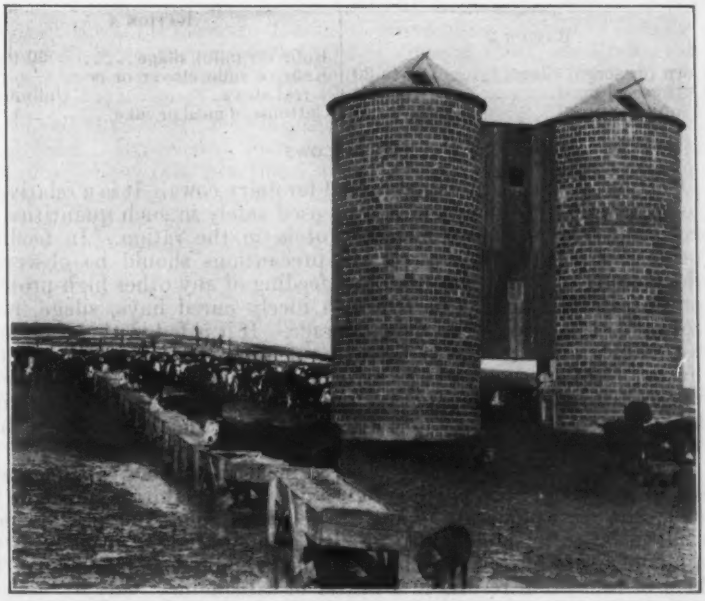

FIGURE 1.—Cottonseed meal and corn silage make a good feed combination for beef cattle. The meal supplies the protein which the silage lacks

BREEDING CATTLE

In feeding cottonseed meal to beef cows, two classifications may be made—dry cows and cows that nurse calves. The dry cows may be handled in much the same manner as stock cattle. The amount of cottonseed meal that should be fed to this class of cows depends on the other feeds used. Some feeders use excessive quantities of cottonseed meal, causing the cost of the ration to become uneconomically high. From 1 to 1½ pounds of cottonseed meal may be fed daily with other feeds, such as corn silage and good hay. Where corn silage is available, a good ration for breeding cows is 25 to 30 pounds silage, from 1 to 1½ pounds cottonseed meal or cake, and other roughage, such as stalks in the field, corn stover, hay, or straw.

Cows that are nursing calves should receive more protein supplements than dry cows, but the amounts fed should not be greater than is necessary to balance properly the other feeds, which may consist largely of roughages. Ordinarily beef cows raising calves are fed not more than 2 pounds each daily, and then only during the winter period.

Suggested rations for wintering beef breeding cows averaging 1,000 pounds in weight

RATION 1

	Pounds
Corn silage	25 to 30
Cereal straw or stover	Unlimited.
Cottonseed meal	1 to 1½

RATION 2

Corn (or sorgo) silage	25 to 30
Cottonseed meal	1 to 1½
Winter pasture.	

RATION 3

	Pounds
Grass hay or stover	18 to 20
Cottonseed meal or cake	1½ to 2

RATION 4

Kafir (or milo) silage	30 to 35
Kafir or milo stover or cereal straw	Unlimited.
Cottonseed meal or cake	1½

DAIRY COWS

Cottonseed meal is a valuable feed for dairy cows. It is a relatively cheap source of protein, and can be used safely in such quantities as are needed to provide sufficient protein in the ration. In feeding cottonseed meal, however, certain precautions should be observed which apply in large measure to the feeding of any other high-protein concentrate. It should be fed with nicely cured hays, silage, root crops, pasture, or other succulent forage. If it is fed in this way, any reasonable quantity may be fed without injury to the cow. Harmful effects of rations containing cottonseed meal or other high-protein concentrate have been reported only when the roughage fed with the concentrate consisted of cottonseed hulls, wheat straw, or other inferior material.

When large quantities of cottonseed meal and a poor roughage are fed to dairy cows, the butter produced is hard, tallowy, and light in color; however, moderate quantities fed with good roughage do not result in butter of undesirable quality. Some kinds of feeds tend to result in a soft butter and the addition of some cottonseed meal to them in the ration results in a butter of satisfactory body.

Suggested rations for a 1,000-pound dairy cow, giving 25 pounds of 4 per cent milk daily

RATION 1

	Pounds
Clover hay	10
Corn (or sorgo) silage	35
Ground corn	3
Wheat bran	2
Cottonseed meal	2

RATION 2

Roots (mangels)	40
Mixed hay	15
Corn-and-cob meal	2
Crushed barley	3
Cottonseed meal	2½

RATION 3

	Pounds
Barley (or oat) hay	15
Clover or alfalfa hay	5
Dried beet pulp	6
Cottonseed meal	3

RATION 4

Corn (or sorgo) silage	35
Grass hay	10
Corn chops	4
Cottonseed meal	3

BULLS AND YOUNG STOCK

Bulls should receive a liberal quantity of protein-rich feeds. Cottonseed meal or cake may be used for the bull to the extent of from 2 to 4 pounds, with other concentrates, such as bran, corn, and oats.

It is highly important that young stock of both beef and dairy breeds intended for breeding purposes be supplied with an abundance of protein and mineral matter. However, it may not be advisable to feed calves up to 6 months of age more than one-half pound per head per day. Calves at 1 year of age may be fed up to 2½ pounds.

HOGS

Cottonseed meal may be fed safely to hogs to the extent of 9 per cent of the total ration. The most economical method of feeding it, however, is to mix it with tankage, linseed meal, or alfalfa meal, and then not to exceed 50 per cent of such mixture.

Before the use of cottonseed meal became general, cattle feeders believed that hogs following the steers in the feed lot might become poisoned. Experience has shown, however, that no detrimental results follow this practice. Evidently the toxic substances have become neutralized in the process of digestion. When the meal or cake fed to the cattle is not accessible to the pigs, there is no danger that the pigs will be poisoned by eating the waste feed in the droppings.

HORSES

The use of cottonseed meal for horses and mules is recommended only in limited quantities, and then care must be exercised in securing cottonseed meal of good quality.

Cottonseed meal has met with considerable disfavor among horse feeders because they say it causes digestive disorders. There may be considerable truth in this statement, because many horses have been killed by the feeding of excessive quantities of cottonseed meal. In too many cases, however, the quality has not always been the best or the quantity safeguarded. Horses are very susceptible to injury from eating moldy feed and this applies particularly to the use of cottonseed products. In the South, plantation owners often feed their mules on cottonseed meal in conjunction with corn with apparently good results. Often it is used in connection with blackstrap molasses and grain.

The meal should be given to horses gradually at first and it should always be used as a supplement to a carbonaceous feed, such as corn. The meal is not relished by horses and, being unpalatable, it should be well incorporated with other feeds. While it has been fed in larger quantities in a few cases, the best results may be obtained by limiting the amount to 1 pound per 1,000 pounds live weight and by giving special attention to the horses receiving the cottonseed meal.

Suggested rations for a 1,000-pound horse at medium work

Ration 1	Pounds
Oats	12
Timothy hay	12
Cottonseed meal	¾

Ration 2	
Shelled corn (dent)	8
Wheat bran	4
Mixed timothy and clover hay	10
Cottonseed meal	¾

Ration 3	Pounds
Rolled barley	10
Oat hay	12
Cottonseed meal	1

Ration 4	
Shelled corn (dent)	9
Molasses (cane)	2
Cowpea hay	6
Sorgo fodder	6
Cottonseed meal	1

SHEEP

In feeding sheep it is highly important to balance properly the rations used. Protein-rich concentrates can be used advantageously

FIGURE 2.—Best carload of grade lambs from range ewes at the 1925 International Livestock Exposition. Fed and exhibited by Purdue University Agricultural Experiment Station. These lambs received a ration consisting, by weight, of seven parts of corn and one part of cottonseed meal fed with corn silage and clover hay

for this purpose. (Fig. 2.) Cottonseed meal and cake have been used for fattening sheep with fairly satisfactory results. In limited quantities they may be used advantageously.

Cottonseed meal and cake are also used to advantage in limited quantities for breeding ewes. One-half pound a day meets their requirements for a protein-rich concentrate.

Sheep should be started on cottonseed products in small quantities. Lambs when on full feed should receive not more than one-third of a pound a day when fed on other concentrates, and only one-eighth to one-fourth of a pound in combination with other grains. It is advisable to use cottonseed meal in connection with corn, oats, or similar grain. Sheep usually relish cottonseed cake more than the finely ground meal.

Suggested rations for a 60-pound fattening lamb

RATION 1

	Pounds
Shelled corn	1.0
Grass hay	1.0
Cottonseed meal	.25

RATION 2

Shelled corn	1.2
Alfalfa	.4
Corn silage	.6
Cottonseed meal	.2

RATION 3

	Pounds
Corn silage	1.2
Barley	1.0
Cottonseed meal	.2
Clover hay	.6

RATION 4

Barley	.6
Wet beet pulp	3.0
Cottonseed meal	.25
Prairie hay	1.0

POULTRY

Cottonseed meal is a fair poultry feed and may often be used economically in poultry rations in sections where it is produced. Vegetable protein feeds do not give as good results with poultry as animal-protein feeds and should always be supplemented with animal proteins as well as with minerals. The following mash for laying hens contains cottonseed meal supplemented with meat scraps and minerals:

	Pounds		Pounds
Yellow corn meal	35	Alfalfa leaf meal	5
Middlings	20	Bone meal	5
Cottonseed meal	10	Ground limestone	2
Meat scraps	12	Salt	1
Bran	10		

This mash should be fed with a good scratch ration which may be made up of the following ingredients, by weight: 2 parts yellow corn, 1 part wheat, and 1 part oats, or 2 parts corn and 1 part wheat.

The use of a ration containing more than 10 per cent of cottonseed meal may produce dark spots or blotches on the yolks of the eggs produced. This is not usually apparent in fresh eggs, but shows up after they have been kept in cold storage. The ration suggested, including both scratch and mash, furnishes only about 5 per cent cottonseed meal.

COTTONSEED MEAL OR CAKE FOR PASTURE FEEDING

For years feeders, of the Southwest particularly, have used from 1 to 2 pounds of cottonseed cake for feeding cows and steers on range in the fall and winter. Somewhat more cottonseed cake or some roughage as suggested on pages 6 and 7 should be fed when the grass is covered with snow and also during periods of grass shortage. The fattening of cattle on grass with cottonseed cake during the spring and summer months has been found during more recent years to be an economical practice. The cake is usually preferred to the meal for grass feeding. In regard to feeding cake in preference to meal, a former publication of the bureau is here quoted.[3]

> There are several advantages in feeding cake in place of meal, especially in summer feeding. A rain does not render the cake unpalatable, but it will often put the meal in such a condition that the cattle will not eat it. Again, no loss is incurred with the cake during windy days, whereas the meal, when fed in the open pasture, is sometimes wasted on account of the high winds. Furthermore, the cake requires chewing before being swallowed and therefore must be eaten

[3] Bureau of Animal Industry Bulletin 131, Beef Production in Alabama.

very much slower than the meal, so when a number of steers are being fed together the greedy one has little chance to get enough cake to produce scours. When cottonseed meal is fed, the greedy steer often scours, because he can bolt the meal and get more than his share; this not only injures the steer but makes the bunch "feed out" unevenly.

In experiments conducted in the Southeast by the Bureau of Animal Industry in which the cake was fed in troughs in the pasture, it was found after several years' work that the feeding of cottonseed cake to cattle on pasture caused the cattle to fatten more rapidly, to develop greater finish, and to make greater profits in most cases than with similar cattle which received pasture alone. The value of the cake as a supplement to pasture, of course, depends to a considerable extent on the nature of the pasture grasses, its use for legumes not being so profitable as with true grasses. As a rule, however, the feeding of cottonseed cake on good grass pasture is not highly profitable. The stage of maturity of the grass is also of significance in this connection, because dry, mature grass is of a more carbonaceous nature than grass in earlier stages of growth.

EXPERIMENTAL RESULTS SHOWING THE VALUE OF COTTONSEED PRODUCTS IN RATIONS

VALUE OF PROTEIN SUPPLEMENT FOR STEER FEEDING

Numerous experiments have conclusively shown the value of protein supplements when added to rations deficient in protein. The following summary covers four experiments, averaging 132 days, with 2-year-old steers, in which a nitrogenous supplement was added to a ration of corn and a carbonaceous roughage.

The addition of the protein supplement increased the average daily gain 0.6 pound a day and reduced the total concentrates required to produce 100 pounds gain from 1,082 pounds to 862 pounds and the roughage from 522 pounds to 402 pounds.

TABLE 4.—*Summary of four feeding experiments showing the value of a protein supplement* [1]

Ration	Number of steers	Average daily gain	Feed per 100 pounds gain		
			Concentrates		Carbonaceous roughage
			Corn	Protein supplement	
		Pounds	*Pounds*	*Pounds*	*Pounds*
Corn and carbonaceous roughage	44	1.60	1,082	----------	522
Corn, protein supplement, and carbonaceous roughage	54	2.20	766	96	402

[1] Bulletin references: Illinois Experiment Station Bulletin 83; Indiana Experiment Station Bulletin 115; Nebraska Experiment Station Bulletins 90 and 93.

COTTONSEED MEAL COMPARED WITH OTHER CONCENTRATES FOR DAIRY COWS

Many experiment stations have fed cottonseed meal to dairy cows in order to compare it with other protein feeds. A condensed statement of the results obtained is shown in Table 5.

TABLE 5.—*Results of feeding experiments showing relative value of cottonseed meal and other concentrates*

Station	Feed with which compared	Result
Florida	Velvetbeans in pod	Cottonseed meal worth from 1.5 to 2.5 times as much.
Maine	Gluten meal	Cottonseed meal superior.
Massachusetts	do	Do.
Do	Ground soybeans	Practically the same.
Mississippi	Cottonseed	Cottonseed meal superior.
Do	do	1 pound cottonseed meal is equal to 1.71 pounds cottonseed.
Do	Velvetbeans in pod	3 pounds velvetbeans superior to 2 pounds cottonseed meal.
New Jersey	Equal parts wheat bran and dried brewers' grains.	4.5 pounds cottonseed meal are practically equal to 10 pounds of the other feeds.
Do	Ground soybeans	Practically the same.
Pennsylvania	Wheat bran	Cottonseed meal increased yield about 20 per cent.
South Carolina	Velvetbean meal	Cottonseed meal slightly superior.
Do	Wheat bran	1.5 pounds cottonseed meal slightly superior to 3 pounds wheat bran.
Tennessee	Ground soybeans	Practically the same.
U. S. Department of Agriculture.	Fish meal	1 pound fish meal is equal to 1.24 pounds cottonseed meal.
Do	Peanut feed	1 pound cottonseed meal is equal to 1.36 pounds peanut feed.
Do	Velvetbean meal	1 pound cottonseed meal is equal to 1.54 pounds velvetbean meal.

Cottonseed meal is higher in protein than any other feed with which a comparison was made with the exception of fish meal. It will be noted in Table 5 that in no case did a feed containing a smaller percentage of protein than the cottonseed meal prove to be better than cottonseed meal. In this comparison the only feed showing results superior to those obtained from cottonseed meal was fish meal.

PASTURE SUPPLEMENTED WITH COTTONSEED CAKE

TABLE 6.—*Value of cottonseed products as a supplement to pasture in steer feeding*[1]

Lot	Ration	Average daily gain	Daily ration of concentrates	Selling price of cattle	Profit per steer
		Pounds	*Pounds*		
Lot A	Pasture alone	1.52		$3.66	$2.86
Lot B	Pasture plus cottonseed cake	2.32	3.31	4.53	10.42

[1] From Bureau of Animal Industry Bulletin 131.

The addition of 3.31 pounds of cottonseed cake a day as a supplement to the grass increased the daily gain 0.80 pound, or from 1.52 to 2.32 pounds. The use of the protein supplement increased the selling prices of the cake-fed cattle, so that they made a much greater profit than the cattle receiving grass alone.

COTTONSEED MEAL AS A SUPPLEMENT TO CORN AND A CARBONACEOUS ROUGHAGE FOR FATTENING LAMBS

In Table 7 the results of four experiments, averaging 80 days, show the effect of adding cottonseed or linseed meal to a ration of timothy hay and corn.

TABLE 7.—*Effect of cottonseed meal or linseed meal as a supplement to timothy hay and corn for lambs* [1]

Ration	Daily gain	Feed for 100 pounds gain	
		Concentrates	Hay
	Pounds	*Pounds*	*Pounds*
Corn 1.2 Timothy hay 1.0	0.23	520	448
Corn 1.2 Timothy hay 1.0 Cottonseed (or linseed) meal .2	.30	463	334

[1] From Ohio Experiment Station Bulletin 245, Minnesota Experiment Station Bulletin 31, and Indiana Experiment Station Bulletin 162.

The use of a small quantity of protein-rich concentrate increased the daily gains 30 per cent and made a saving of 57 pounds of concentrates and 114 pounds of roughage per 100 pounds gain.

LINSEED MEAL AND COTTONSEED MEAL FOR FATTENING SHEEP

TABLE 8.—*Summaries of sheep-fattening experiments showing comparative value of linseed meal and cottonseed meal* [1]

Ration	Initial weight	Daily gain	Feed for 100 pounds gain	
			Concentrates	Hay
Ohio station, 112-day trial:				
Lot 1. 40 lambs—	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Linseed meal 0.2 Shelled corn 1.0 Clover or alfalfa hay 1.5	65	0.30	397	497
Lot 2. 40 lambs—				
Cottonseed meal 0.2 Shelled corn 1.0 Clover or alfalfa hay 1.5	67	.31	388	486
Missouri station, 98-day trial:				
Lot 1. 20 yearling wethers—				
Linseed meal 0.2 Shelled corn 1.1 Clover hay 1.8	79	.25	491	703
Lot 2. 20 yearling wethers—				
Cottonseed meal 0.2 Shelled corn 1.1 Clover hay 1.8	78	.24	511	748

[1] From Ohio Experiment Station Bulletin 179 and Missouri Experiment Station Bulletin 115.

In the trials listed in Table 8 cottonseed meal and linseed meal showed substantially the same value for balancing the rations of fattening lambs and wethers. Whether to use cottonseed or linseed meal as a protein supplement for fattening sheep depends to a very large extent on their relative prices and availability.

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FEEDING COTTONSEED PRODUCTS TO LIVESTOCK

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IN REGIONS where much corn, stover, fodder, timothy, or other carbohydrate feed is used, it is important to use some feed that is high in protein, such as cottonseed meal.

Cottonseed meal stimulates the appetite of fattening animals and causes them to consume more feed and consequently to make greater gains.

Cottonseed cake or meal may be used satisfactorily as a supplemental feed for fattening beef cattle on pasture.

Cottonseed meal is a very valuable protein feed for dairy cows. One pound of good-quality cottonseed meal furnishes as much digestible protein as 3 pounds of wheat bran. Like wheat bran, cottonseed meal is high in phosphorus.

For high-producing dairy cows, however, the addition of cottonseed meal to rations of the type mentioned renders them satisfactory only so far as the protein requirement is concerned.

Hogs may be fed limited quantities of cottonseed meal as a protein supplement.

Horses may be fed cottonseed products only in small quantities and then with great caution.

Procure prices on various grades of cottonseed meal or cake and choose the feed which supplies a pound of protein at the least cost.

Washington, D. C.

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FEEDING COTTONSEED PRODUCTS TO LIVESTOCK

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VALUE OF COTTONSEED PRODUCTS AS LIVESTOCK FEEDS

COTTONSEED PRODUCTS have been extensively fed to stock in the South for many years. More recently their use has become general in many sections outside the Cotton Belt. Demand from foreign countries is strong, although these products cost considerably more there than in this country. European feeders, as a rule, have placed more value on high-protein feeds than the average American livestock man does. Another reason, in addition to their high protein content, why cottonseed products are so important is their immense production.

Other protein feeds, such as soybean cake, peanut cake, copra cake, linseed meal, fish meal, and meat meal, are available as protein supplements. Roughly these feeds are similar in nutritive value. They differ somewhat in the relative protein value and in vitamins and inorganic matter.

COMPOSITION OF COTTONSEED PRODUCTS

Many cottonseed products, both concentrates and roughages, are used as livestock feeds. All the concentrate products have the same general characteristics and qualities, their chemical composition depending mainly on the form of manufacture and the thoroughness in separating out the hulls. Among the more common cottonseed products used as feeds are cottonseed, cottonseed meal and cake, and cottonseed hulls. Table 1 gives analyses representing these products, marketed by manufacturers to conform to the definitions adopted by the Association of Feed Control Officials of the United States.

Untreated cottonseed contains a substance called gossypol, which is toxic to animals. This substance is made inactive by cooking the seed after the addition of water. Similarly, the cooking and expelling

[1] Mr. Sheets left the Department in October 1934. Mr. Thompson died Oct. 6, 1924. The bulletin has been revised by specialists in the Animal Nutrition and Animal Husbandry Divisions.

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processes to which cottonseed meal is subjected in order to remove the oil are in large measure destructive to the toxic principle in the raw seed. The extent to which each step in the varied methods of manufacture of cottonseed oil and cottonseed meal affects the toxicity of the meal is not yet determined, and it is possible, that when this knowledge is obtained and applied, the meal can be fed economically in larger quantities than at present.

TABLE 1.—*Composition of cottonseed products* [1]

[Pounds of nutrients in 100 pounds]

Product	Water	Ash	Crude protein	Carbohydrates		Fat (ether extract)
				Fiber	Nitrogen-free extract	
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Cottonseed	9.1	4.0	19.6	18.9	28.3	20.1
Cottonseed meal and cake:						
41 per cent protein	7.1	5.7	41.7	10.0	28.4	7.1
38.6 per cent protein	6.9	5.9	38.8	12.2	29.4	6.8
36 per cent protein	7.3	5.8	36.8	13.5	30.0	6.6
Cold-pressed cottonseed	6.9	4.2	27.5	24.2	30.2	7.0
Cottonseed hulls	8.7	2.6	3.5	46.2	38.0	1.0

[1] Furnished by the Bureau of Chemistry and Soils, U. S. Department of Agriculture.

Cottonseed is a good source of protein, potash, and phosphorus, but is deficient in calcium and carotene (vitamin A). An adequate quantity of calcium is especially important to milking or nursing animals and to young stock and may be supplied satisfactorily by legume hays or as a mineral supplement. Some nutritional failures attributed to cottonseed meal have been the result of using it with poor-quality roughages, such as hulls or straw. A satisfactory ration in which cottonseed meal is used as the concentrate should contain an adequate supply of carotene and possibly certain other nutritive elements supplied by such roughages as legume or other hays of good quality or by pasturage.

GRADES AND CLASSES OF COTTONSEED PRODUCTS

Cottonseed (uncrushed) was formerly used extensively as a feed for livestock. Its value as a source of cottonseed oil and its utilization for commercial purposes have greatly decreased the amount fed in the form of seed. Cottonseed products have largely taken the place of the seed as a feedstuff. Several feeding tests have indicated that 1 pound of good-quality cottonseed meal is equal to nearly 2 pounds of cottonseed as a feed for fattening steers. Large rations of cottonseed tend to produce scours, but when used in quantities up to 5 or 6 pounds there is little or no trouble of this sort.

Cottonseed contains about 20 per cent each of fat or oil and crude protein. Compared with a good grade of cottonseed meal it contains about half as much protein and about three times the content of oil.

A ton of cottonseed will yield approximately the following quantities of products: Linters or short fiber, 110 pounds; hulls, 514 pounds; cake or meal, 954 pounds; crude oil, 303 pounds; dirt and loss in manufacture, 119 pounds.

Cottonseed cake is the residue remaining after the oil has been pressed or extracted from the seed. Ordinarily the greater part of

the hulls is removed before the oil is removed. When this is done the amount of crude fiber in the resulting cake is proportionately smaller. The hulled kernels are crushed, heated, and subjected to great pressure to remove the oil. The residue when of prime quality should be a hard, boardlike cake of a yellowish color. The color is often an indication of the quality. The presence of hulls gives the cake a dark appearance. A dark color may also be caused by overheating during the pressing process or by fermentation, each of which lessens the feeding value.

Cottonseed cake and cottonseed meal are practically one and the same thing; that is, the meal is the cake in a ground form. The meal is most commonly used, but the cake has a distinct advantage in certain cases. European buyers show a preference for the cake for the reasons that there is less loss in handling, it is easier to judge the quality, and it is better adapted for feeding alone or on the ground. Ocean freight rates also are lower for the cake than for the meal.

In the United States the cake is preferred by men who feed their cattle in the open where the wind may blow the meal away. On the range or pasture the cake is often broken up and fed in troughs or spread on the ground. If meal were used, the loss in feeding in this manner would be very large.

Many grades and classes of cottonseed products are sold on the market. The grades as classified and described by the Association of Feed Control Officials of the United States are as follows:

Cottonseed meal is a product of the cottonseed only, composed principally of the kernel with such portion of the hull as is necessary in the manufacture of oil, provided that nothing shall be recognized as cottonseed meal that does not conform to the foregoing definition and that does not contain at least 36 per cent of protein. Cottonseed meal shall be graded and classed as follows:

1. Cottonseed meal, prime quality. Cottonseed meal, prime quality, must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color, yellowish, not brown or reddish, free from excessive lint, and shall contain not less than 36 per cent of protein. It shall be designated and sold according to its protein content. Cottonseed meal with 36 per cent of protein shall be termed "36 per cent protein cottonseed meal, prime quality," and higher grades similarly designated (as "43 per cent protein cottonseed meal, prime quality"), etc.

2. Cottonseed meal, off quality. Cottonseed meal not fulfilling the above requirements as to color, odor, and texture shall be graded "36 per cent protein cottonseed meal, off quality," and higher grades similarly designated.

Cottonseed feed is a mixture of cottonseed meal and cottonseed hulls, containing less than 36 per cent of protein.

Cold-pressed cottonseed is the product obtained from the subjection of the whole undecorticated cottonseed to the cold-pressure process for the extraction of oil and includes the entire cottonseed less the oil extracted.

Ground, cold-pressed cottonseed is the product obtained by grinding cold-pressed cottonseed.

Cottonseed hulls are the roughage product of cottonseed-oil manufacture. The hulls are removed from the cottonseed before the oil is extracted. They have a very low-protein content and should be fed only in connection with protein-rich feeds. As a roughage the hulls have a lower feeding value than oat straw or corn stover, but are valuable where no other roughage is available. This product is used extensively in the South, especially for steer feeding.

Cottonseed-hull bran is ground cottonseed hulls from which the lint has been removed. The feeding value of the bran is not appreciably greater than that of ordinary cottonseed hulls.

ECONOMY OF USING HIGH-GRADE COTTONSEED PRODUCTS

Cottonseed products containing a high percentage of protein command relatively high prices, but judged from the cost of the protein contained, they are comparatively cheap. Some feeders prefer to buy the lower-grade products, believing them to be more economical than the better grades. From the standpoint of the cost of the protein in the feeds such men are usually deceiving themselves. These products are usually purchased for their protein content, and prices paid should be based on the protein contained in them. To show the value per pound of the protein in feeds at various prices and containing varying guaranteed analyses of protein, Table 2 has been prepared.

TABLE 2.—*Cost of protein per pound in feeds at various prices per ton*

Cost of feed per ton	Per cent of protein in feeds										
	12	16	20	24	28	32	36	38	41	43	45
	Cost per pound of protein										
	Cents	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*
$10.00	4.17	3.13	2.50	2.08	1.79	1.56	1.39	1.32	1.22	1.16	1.11
15.00	6.25	4.69	3.75	3.13	2.68	2.34	2.08	1.97	1.83	1.74	1.67
20.00	8.33	6.25	5.00	4.17	3.57	3.13	2.78	2.63	2.44	2.33	2.22
25.00	10.42	7.82	6.25	5.23	4.47	3.91	3.47	3.29	3.05	2.91	2.77
30.00	12.50	9.38	7.50	6.25	5.36	4.69	4.16	3.95	3.66	3.48	3.38
35.00	14.58	10.94	8.75	7.29	6.25	5.47	4.86	4.61	4.26	4.07	3.89
40.00	16.67	12.50	10.00	8.33	7.14	6.25	5.55	5.26	4.88	4.65	4.44
45.00	18.75	14.06	11.25	9.38	8.03	7.03	6.25	5.92	5.49	5.23	5.00
50.00	20.83	15.63	12.50	10.42	8.93	7.81	6.94	6.58	6.09	5.81	5.55
55.00	22.91	17.19	13.75	11.46	9.82	8.59	7.64	7.24	6.71	6.40	6.11
60.00	25.00	18.75	15.00	12.50	10.71	9.38	8.33	7.89	7.32	6.97	6.67
65.00	27.08	20.31	16.25	13.54	11.67	10.16	9.03	8.55	7.92	7.56	7.22
70.00	29.16	21.87	17.50	14.58	12.50	10.94	9.72	9.21	8.53	8.14	7.78
75.00	31.25	23.44	18.75	15.62	13.39	11.72	10.41	9.87	9.14	8.72	8.33
80.00	33.33	25.00	20.00	16.67	14.28	12.50	11.11	10.53	9.75	9.32	8.89
85.00	35.41	26.56	21.25	17.71	15.18	13.28	11.80	11.18	10.36	9.88	9.44

The poorer grades of cottonseed meal or cake usually sell only a little lower than the prices for the higher-grade products. By obtaining commercial prices on both high-grade and low-grade products and referring to Table 2, one can ascertain approximately which feed will provide protein at the least cost. It must be remembered, however, that the feeding values of different feeds having essentially the same coefficients of digestibility are not exactly proportional to their respective protein contents. A low-protein feed usually has a higher content of carbohydrates, which may partially make up in feeding value for the difference in protein content.

Good cottonseed meal contains three times as much digestible protein and as much digestible carbohydrates and fat combined as there is in wheat bran. One pound of cottonseed meal will balance as much corn as 3 pounds of bran.

Sometimes the analysis of cottonseed meal offered for sale is given on the tag in terms of nitrogen or of ammonia, or it may be quoted in those terms by feed dealers. One may readily determine the protein content by using the following factors:

Multiply the nitrogen by 6.25. For example, if the analysis is given as 6 per cent nitrogen, then the pounds of protein in 100 pounds

of the meal will be 6×6.25, which is 37.50. This means that it is above the minimum requirements for prime quality cottonseed meal.

If the analysis is given in terms of ammonia, multiply the per cent of ammonia by 5.15. For example, if the analysis is given as 7.5 per cent ammonia, the protein in 100 pounds of the meal will be 7.5×5.15, which is 38.62.

COTTONSEED PRODUCTS FOR VARIOUS CLASSES OF LIVESTOCK

The rations given in the succeeding pages may be used as the average and may be adjusted to suit local conditions. If the suggested rations can not be used, one may substitute other feeds of the same general character as those included in the rations outlined. These rations are primarily designed to show the proper proportions in which to use cottonseed products and no attempt is made to cover all conditions.

In discussions of feeding cottonseed products, the quantities for the different classes of animals are given in pounds. While it is important to weigh the meal as fed, yet it may be entirely satisfactory merely to weigh at frequent intervals the contents of a certain measure or vessel. Table 3, giving weights and measures, may be helpful along this line.

TABLE 3.—*Equivalent weights and measures of cottonseed products*

Product	1 quart weighs—	1 pound measures—
	Pounds	*Quarts*
Cottonseed	0.8	1.3
Cottonseed meal	1.5	.7
Cottonseed hulls	.3	3.3

FATTENING CATTLE IN THE DRY LOT

Fattening or carbohydrate feeds should be fed in conjunction with roughages and supplemented with feeds rich in protein. In many of the fattening areas the protein supply is limited, and accordingly is one of the factors of most importance to the cattle feeder. When there is an abundance of legume hay, such as clover or alfalfa, and its market value is not excessive, it is perhaps unnecessary to supply any additional protein in the form of a meal or cake. However, when protein can be supplied more cheaply in the latter form, it may be advisable to replace part of the hay with a meal or cake.

Protein concentrates, such as cottonseed meal or cake, are used generally in rations in which straw, stovers, or silage makes up the roughage. In buying cottonseed products as a source of protein it is usually advisable to purchase the feed that will supply protein most cheaply. This can be easily determined if the percentage of protein and price per ton are known. For example, cottonseed meal having a protein content of 45 per cent and priced at $25 a ton will supply protein more cheaply than 36 per cent meal at $20 a ton. (Table 2.)

In many sections of the South there is a shortage of carbohydrate feeds (grains) for fattening purposes, and under these conditions considerable quantities of cottonseed hulls are fed in conjunction with cottonseed meal. This type of ration is more adaptable to cattle 2 years old and over, and for short feeding periods.

Suggested rations for fattening steers averaging 1,000 pounds in weight

Ration 1	Pounds
Corn or barley (ground)	20
Mixed hay	10
Cottonseed meal	3

Ration 2	
Corn	18
Mixed hay	5
Corn silage	20
Cottonseed meal	4

Ration 3	Pounds
Kafir or other grain sorghums	20
Sorgo fodder	15
Cottonseed meal or cake	4

Ration 4	
Molasses	3
Cottonseed hulls	25
Cottonseed meal	7

FATTENING CATTLE ON GRASS

Cottonseed products are used liberally as supplements in the fattening of cattle on grass. Cottonseed cake is frequently used as the sole supplemental feed, but more often cottonseed meal or cake is used in a mixture with corn or other grain. A desirable mixture for use as a supplement for cattle on grass is 8 parts by weight of corn or other grain and 2 parts of cottonseed meal or cake. Cattle fattened on grass with a supplement are usually allowed all the feed they will eat once a day in addition to grass. Usually cattle on pasture will not eat more than one-half the feed that would ordinarily be eaten in dry-lot feeding.

STOCK CATTLE

For stock cattle the use of cottonseed meal is ordinarily confined to the winter period, and then only in amounts sufficient to supply the necessary protein. It is especially valuable to use in connection with cheap roughages and silages. For stock cattle weighing from 500 to 750 pounds, from 1 to 2 pounds of the meal is enough to balance most roughage rations properly. If legume hays, such as alfalfa or clover, constitute half or more of the roughage ration, there is little or no need of the use of cottonseed meal.

Few combinations are more economical than a ration of corn silage and cottonseed meal for wintering stock cattle. One to two pounds of cottonseed meal combined with whatever silage stock cattle will eat should keep them in good, thrifty condition and cause them to make a satisfactory gain. The cost of wintering such cattle can usually be lessened by permitting them to run in the stalk fields and giving them feed at night only. Straw and other roughages which can not be used to advantage in any other way may be fed with silage and cottonseed meal.

Suggested rations for wintering stockers averaging 750 pounds in weight

RATION 1

	Pounds
Corn (or sorgo) silage	25
Oat or wheat straw	Unlimited.
Cottonseed meal	½ to 1½

RATION 2

Corn (or sorgo) silage	25
Oats or corn	2
Cottonseed meal	½
Straw or stover	Unlimited.

RATION 3

	Pounds
Cottonseed hulls	15 to 20
Grass hay	5
Cottonseed meal	2

RATION 4

Cottonseed cake	1 to 1½
Silage, to supplement winter pastures	15 to 20

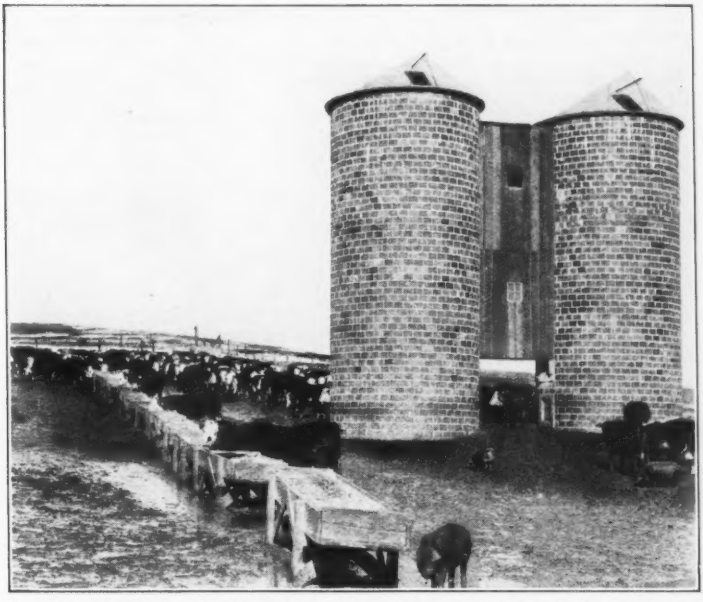

FIGURE 1.—Cottonseed meal and corn silage make a good feed combination for beef cattle. The meal supplies the protein which the silage lacks

BREEDING CATTLE

In feeding cottonseed meal to beef cows, two classifications may be made—dry cows and cows that nurse calves. The dry cows may be handled in much the same manner as stock cattle. The amount of cottonseed meal that should be fed to this class of cows depends on the other feeds used. Some feeders use excessive quantities of cottonseed meal, causing the cost of the ration to become uneconomically high. From 1 to 1½ pounds of cottonseed meal may be fed daily with other feeds, such as corn silage and good hay. Where corn silage is available, a good ration for breeding cows is 25 to 30 pounds silage, from 1 to 1½ pounds cottonseed meal or cake, and other roughage, such as stalks in the field, corn stover, hay, or straw.

Cows that are nursing calves should receive more protein supplements than dry cows, but the amounts fed should not be greater than is necessary to balance properly the other feeds, which may consist largely of roughages. Ordinarily beef cows raising calves are fed not more than 2 pounds each daily, and then only during the winter period.

Suggested rations for wintering beef breeding cows averaging 1,000 pounds in weight

RATION 1

	Pounds
Corn silage	25 to 30
Cereal straw or stover	Unlimited.
Cottonseed meal	1 to 1½

RATION 2

Corn (or sorgo) silage	25 to 30
Cottonseed meal	1 to 1½
Winter pasture.	

RATION 3

	Pounds
Grass hay or stover	18 to 20
Cottonseed meal or cake	1½ to 2

RATION 4

Kafir (or milo) silage	30 to 35
Kafir or milo stover or cereal straw	Unlimited.
Cottonseed meal or cake	1½

DAIRY COWS

Cottonseed meal is a valuable feed for dairy cows. It is a relatively cheap source of protein, and can be used safely in such quantities as are needed to provide sufficient protein in the ration. In feeding cottonseed meal, however, certain precautions should be observed which apply in large measure to the feeding of any other high-protein concentrate. It should be fed with nicely cured hays, silage, pasture, or other green forage. If it is fed in this way, any reasonable quantity may be fed without injury to the cow. Harmful effects of rations containing cottonseed meal or other high-protein concentrate have been reported only when the roughage fed with the concentrate consisted of cottonseed hulls, wheat straw, or other inferior material.

When large quantities of cottonseed meal and a poor roughage are fed to dairy cows, the butter produced is hard, tallowy, and light in color; however, moderate quantities fed with good roughage do not result in butter of undesirable quality. Some kinds of feeds tend to result in a soft butter and the addition of some cottonseed meal to them in the ration results in a butter of satisfactory body.

Suggested rations for a 1,000-pound dairy cow, giving 25 pounds of 4 per cent milk daily

RATION 1

	Pounds
Clover hay	10
Corn (or sorgo) silage	35
Ground corn	3
Wheat bran	2
Cottonseed meal	2

RATION 2

Roots (mangels)	40
Mixed hay	15
Corn-and-cob meal	3
Crushed barley	3
Cottonseed meal	2½

RATION 3

	Pounds
Barley (or oat) hay	15
Clover or alfalfa hay	5
Dried beet pulp	6
Cottonseed meal	3

RATION 4

Corn (or sorgo) silage	35
Grass hay	10
Corn chops	3
Cottonseed meal	4

BULLS AND YOUNG STOCK

Bulls should receive a liberal quantity of protein-rich feeds. Cottonseed meal or cake may be used for the bull to the extent of from 2 to 4 pounds, with other concentrates, such as bran, corn, and oats.

It is highly important that young stock of both beef and dairy breeds intended for breeding purposes be supplied with an abundance of protein and mineral matter. However, it may not be advisable to feed calves up to 6 months of age more than one-half pound per head per day. Calves at 1 year of age may be fed up to 2½ pounds.

HOGS

Cottonseed meal may be fed safely to hogs to the extent of 9 per cent of the total ration. The most economical method of feeding it, however, is to mix it with tankage, linseed meal, or alfalfa meal, and then not to exceed 50 per cent of such mixture.

Before the use of cottonseed meal became general, cattle feeders believed that hogs following the steers in the feed lot might become poisoned. Experience has shown, however, that no detrimental results follow this practice. Evidently the toxic substances have become neutralized in the process of digestion. When the meal or cake fed to the cattle is not accessible to the pigs, there is no danger that the pigs will be poisoned by eating the waste feed in the droppings.

HORSES

Cottonseed meal may be used as a protein supplement in rations for horses and mules. Its use is recommended only in limited quantities, and then care must be exercised in obtaining cottonseed meal of good quality.

Cottonseed meal has met with some disfavor among horse feeders because they say it causes digestive disorders. There may be considerable truth in this statement, because many horses have been killed by the feeding of excessive quantities of cottonseed meal. In too many cases, however, the quality has not always been the best or the quantity safeguarded. Horses are very susceptible to injury from eating moldy feed, and this applies particularly to the use of cottonseed products. In the South, plantation owners often feed their mules on cottonseed meal in conjunction with corn with apparently good results. Often it is used in connection with black-strap molasses and grain.

The meal should be given to horses gradually at first and it should always be used as a supplement to a carbonaceous feed, such as corn. The meal is not relished by horses and, being unpalatable, it should be well incorporated with other feeds. While it has been fed in larger quantities in a few cases, the best results may be obtained by limiting the amount to from 1 to 1½ pounds per 1,000 pounds live weight and by giving special attention to the horses receiving the cottonseed meal.

XUM

Suggested rations for a 1,000-pound horse at medium work

Ration 1	Pounds
Oats	12
Timothy hay	12
Cottonseed meal	¾

Ration 2	
Shelled corn (dent)	8
Wheat bran	4
Mixed timothy and clover hay	10
Cottonseed meal	¾

Ration 3	Pounds
Rolled barley	10
Oat hay	12
Cottonseed meal	1

Ration 4	
Shelled corn (dent)	9
Molasses (cane)	2
Cowpea hay	6
Sorgo fodder	6
Cottonseed meal	1

SHEEP

In feeding sheep it is highly important to balance properly the rations used. Protein-rich concentrates can be used advantageously

FIGURE 2.—Best carload of grade lambs from range ewes at the 1925 International Livestock Exposition. Fed and exhibited by Purdue University Agricultural Experiment Station. These lambs received a ration consisting, by weight, of seven parts of corn and one part of cottonseed meal fed with corn silage and clover hay

for this purpose (fig. 2). Cottonseed meal and cake have been used for fattening sheep with satisfactory results. In limited quantities they have been found one of the best types of protein-rich supplements for sheep.

Cottonseed meal and cake are also used to advantage in limited quantities for breeding ewes. One-half pound a day meets their requirements for a protein-rich concentrate, although these feeds are usually fed in connection with grains, forming from 10 to 15 percent of the grain ration.

Sheep should be started on cottonseed products in small quantities. Lambs when on full feed should receive not more than one-third of a pound a day when fed on other concentrates, and only one-eighth to one-fourth of a pound in combination with other grains. It is advisable to use cottonseed meal in connection with corn, oats, or similar grain. Sheep usually relish cottonseed cake more than the finely ground meal.

Suggested rations for a 60-pound fattening lamb

RATION 1

	Pounds
Shelled corn	1. 0
Grass hay	1. 0
Cottonseed meal	. 25

RATION 2

Shelled corn	1. 2
Alfalfa	. 4
Corn silage	. 6
Cottonseed meal	. 2

RATION 3

	Pounds
Corn silage	1. 2
Barley	1. 0
Cottonseed meal	. 2
Clover hay	. 6

RATION 4

Barley	. 6
Wet beet pulp	3. 0
Cottonseed meal	. 25
Prairie hay	1. 0

POULTRY

Cottonseed meal is a fair source of protein for diets to be fed to growing chicks, but it should not be used in diets for laying chickens because of the effect it has on yolk color. When large quantities of cottonseed meal—30 per cent or more—are included in the diet of laying hens, most of the eggs will have mottled yolks. When such eggs are stored for a few weeks, the yolks may acquire a brown or chocolate color. Even if as little as 5 per cent of cottonseed meal is fed, mottling and off colors may develop in the yolks after they have been stored a few months.

Although cottonseed meal should not be fed to laying chickens, it may be used to advantage in diets for growing chicks. The following mash diets contain the proper quantities of cottonseed meal.

ALL-MASH STARTING AND GROWING DIET

	Pounds
Ground yellow corn	39. 0
Finely ground oats	10. 0
Wheat middlings	16. 0
Dried skim milk	10. 0
Meat-and-bone scrap	5. 0
Fish meal	5. 0
Alfalfa leaf meal	5. 0
Cottonseed meal	8. 0
Ground limestone	1. 0
Salt mixture	0. 5
Cod-liver oil	0. 5
Total	100. 0

STARTING AND GROWING MASH WITH WHICH GRAIN IS TO BE FED AFTER THE CHICKS ARE 4 TO 6 WEEKS OLD

	Pounds
Ground yellow corn	25. 3
Finely ground oats	10. 0
Wheat middlings	20. 0
Dried skim milk	10. 0
Meat-and-bone scrap	5. 0
Fish meal	5. 0
Alfalfa leaf meal	10. 0
Cottonseed meal	10. 0
Ground limestone	1. 7
Salt mixture	1. 0
Special steamed bonemeal	1. 0
Cod-liver oil	1. 0
Total	100. 0

The salt mixture is prepared by mixing 100 parts of salt and 2.2 parts of anhydrous manganous sulphate. If anhydrous manganous sulphate is not available, 3.2 parts of manganous sulphate-tetrahydrate may be used. These mixtures are preferable to salt alone.

The grain to be fed with the above starting and growing mash may consist (1) entirely of corn, (2) of equal parts of corn and wheat, (3) of equal parts of corn, wheat, and oats, (4) of 2 parts of corn and 1 part of oats, or (5) of any other suitable grain or combination of grains.

COTTONSEED MEAL OR CAKE FOR PASTURE FEEDING

For years feeders, of the Southwest particularly, have used from 1 to 2 pounds of cottonseed cake for feeding cows and steers on range

in the fall and winter. Somewhat more cottonseed cake or some roughage as suggested on pages 6 and 7 should be fed when the grass is covered with snow and also during periods of grass shortage. The fattening of cattle on grass with cottonseed cake during the spring and summer months has been found during more recent years to be an economical practice. The cake is usually preferred to the meal for grass feeding. In regard to feeding cake in preference to meal, a former publication of the bureau is here quoted.[3]

There are several advantages in feeding cake in place of meal, especially in summer feeding. A rain does not render the cake unpalatable, but it will often put the meal in such a condition that the cattle will not eat it. Again, no loss is incurred with the cake during windy days, whereas the meal, when fed in the open pasture, is sometimes wasted on account of the high winds. Furthermore, the cake requires chewing before being swallowed and therefore must be eaten very much slower than the meal, so when a number of steers are being fed together the greedy one has little chance to get enough cake to produce scours. When cottonseed meal is fed, the greedy steer often scours, because he can bolt the meal and get more than his share; this not only injures the steer but makes the bunch "feed out" unevenly.

In experiments conducted in the Southeast by the Bureau of Animal Industry in which the cake was fed in troughs in the pasture, it was found after several years' work that the feeding of cottonseed cake to cattle on pasture caused the cattle to fatten more rapidly, to develop greater finish, and to make greater profits in most cases than with similar cattle which received pasture alone. The value of the cake as a supplement to pasture, of course, depends to a considerable extent on the nature of the pasture grasses, its use for legumes not being so profitable as with true grasses. As a rule, however, the feeding of cottonseed cake on good grass pasture is not highly profitable. The stage of maturity of the grass is also of significance in this connection, because dry, mature grass is of a more carbonaceous nature than grass in earlier stages of growth.

EXPERIMENTAL RESULTS SHOWING THE VALUE OF COTTONSEED PRODUCTS IN RATIONS

VALUE OF PROTEIN SUPPLEMENT FOR STEER FEEDING

Numerous experiments have conclusively shown the value of protein supplements when added to rations deficient in protein. The following summary covers four experiments, averaging 132 days, with 2-year-old steers, in which a nitrogenous supplement was added to a ration of corn and a carbonaceous roughage.

TABLE 4.—*Summary of four feeding experiments showing the value of a protein supplement*[1]

Ration	Number of steers	Average daily gain	Feed per 100 pounds gain		
			Concentrates		Carbonaceous roughage
			Corn	Protein supplement	
		Pounds	*Pounds*	*Pounds*	*Pounds*
Corn and carbonaceous roughage	44	1.60	1,082	----------	522
Corn, protein supplement, and carbonaceous roughage	54	2.20	766	96	402

[1] Bulletin references: Illinois Experiment Station Bulletin 83; Indiana Experiment Station Bulletin 115; Nebraska Experiment Station Bulletins 90 and 93.

[2] Bureau of Animal Industry Bulletin 131, Beef Production in Alabama. Out of print.

The addition of the protein supplement increased the average daily gain 0.6 pound a day and reduced the total concentrates required to produce 100 pounds gain from 1,082 pounds to 862 pounds and the roughage from 522 pounds to 402 pounds.

COTTONSEED MEAL COMPARED WITH OTHER CONCENTRATES FOR DAIRY COWS

Many experiment stations have fed cottonseed meal to dairy cows in order to compare it with other protein feeds. A condensed statement of the results obtained is shown in Table 5.

TABLE 5.—*Results of feeding experiments showing relative value of cottonseed meal and other concentrates*

Station	Feed with which compared	Result
Florida	Velvetbeans in pod	Cottonseed meal worth from 1.5 to 2.5 times as much.
Maine	Gluten meal	Cottonseed meal superior.
Massachusetts	do	Do.
Do	Ground soybeans	Practically the same.
Mississippi	Cottonseed	Cottonseed meal superior.
Do	do	1 pound cottonseed meal is equal to 1.71 pounds cottonseed.
Do	Velvetbeans in pod	3 pounds velvetbeans superior to 2 pounds cottonseed meal.
New Jersey	Equal parts wheat bran and dried brewers' grains.	4.5 pounds cottonseed meal are practically equal to 10 pounds of the other feeds.
Do	Ground soybeans	Practically the same.
Pennsylvania	Wheat bran	Cottonseed meal increased yield about 20 per cent.
South Carolina	Velvetbean meal	Cottonseed meal slightly superior.
Do	Wheat bran	1.5 pounds cottonseed meal slightly superior to 3 pounds wheat bran.
Tennessee	Ground soybeans	Practically the same.
U. S. Department of Agriculture.	Fish meal	1 pound fish meal is equal to 1.24 pounds cottonseed meal.
Do	Peanut feed	1 pound cottonseed meal is equal to 1.36 pounds peanut feed.
Do	Velvetbean meal	1 pound cottonseed meal is equal to 1.54 pounds velvetbean meal.

Cottonseed meal is higher in protein than any other feed with which a comparison was made with the exception of fish meal. It will be noted in Table 5 that in no case did a feed containing a smaller percentage of protein than the cottonseed meal prove to be better than cottonseed meal. In this comparison the only feed showing results superior to those obtained from cottonseed meal was fish meal.

PASTURE SUPPLEMENTED WITH COTTONSEED CAKE

TABLE 6.—*Value of cottonseed products as a supplement to pasture in steer feeding*[1]

Lot	Ration	Average daily gain	Concentrates fed daily	Selling price of cattle	Profit per steer
		Pounds	*Pounds*		
Lot A	Pasture alone	1.52		$3.66	$2.86
Lot B	Pasture plus cottonseed cake	2.32	3.31	4.53	10.42

[1] From Bureau of Animal Industry Bulletin 131.

The addition of 3.31 pounds of cottonseed cake a day as a supplement to the grass increased the daily gain 0.80 pound, or from 1.52 to 2.32 pounds. The use of the protein supplement increased the selling prices of the cake-fed cattle, so that they made a much greater profit than the cattle receiving grass alone.

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COTTONSEED MEAL AS A SUPPLEMENT TO CORN AND A CARBONACEOUS ROUGHAGE FOR FATTENING LAMBS

In Table 7 the results of four experiments, averaging 80 days, show the effect of adding cottonseed or linseed meal to a ration of timothy hay and corn.

TABLE 7.—*Effect of cottonseed meal or linseed meal as a supplement to timothy hay and corn for lambs* [1]

Ration	Daily gain	Feed for 100 pounds gain	
		Concentrates	Hay
	Pounds	*Pounds*	*Pounds*
Corn 1.2 Timothy hay 1.0	0.23	520	448
Corn 1.2 Timothy hay 1.0 Cottonseed (or linseed) meal .2	.30	463	334

[1] From Ohio Experiment Station Bulletin 245, Minnesota Experiment Station Bulletin 31, and Indiana Experiment Station Bulletin 162.

The use of a small quantity of protein-rich concentrate increased the daily gains 30 per cent and made a saving of 57 pounds of concentrates and 114 pounds of roughage per 100 pounds gain.

LINSEED MEAL AND COTTONSEED MEAL FOR FATTENING SHEEP

TABLE 8.—*Summaries of sheep-fattening experiments showing comparative value of linseed meal and cottonseed meal* [1]

Ration	Initial weight	Daily gain	Feed for 100 pounds gain	
			Concentrates	Hay
Ohio station, 112-day trial:				
Lot 1. 40 lambs—	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Linseed meal 0.2 Shelled corn 1.0 Clover or alfalfa hay 1.5	65	0.30	397	497
Lot 2. 40 lambs—				
Cottonseed meal 0.2 Shelled corn 1.0 Clover or alfalfa hay 1.5	67	.31	388	486
Missouri station, 98-day trial:				
Lot 1. 20 yearling wethers—				
Linseed meal 0.2 Shelled corn 1.1 Clover hay 1.8	79	.25	491	703
Lot 2. 20 yearling wethers—				
Cottonseed meal 0.2 Shelled corn 1.1 Clover hay 1.8	78	.24	511	748

[1] From Ohio Experiment Station Bulletin 179 and Missouri Experiment Station Bulletin 115.

In the trials listed in Table 8 cottonseed meal and linseed meal showed substantially the same value for balancing the rations of fattening lambs and wethers. Whether to use cottonseed or linseed meal as a protein supplement for fattening sheep depends to a very large extent on their relative prices and availability.

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